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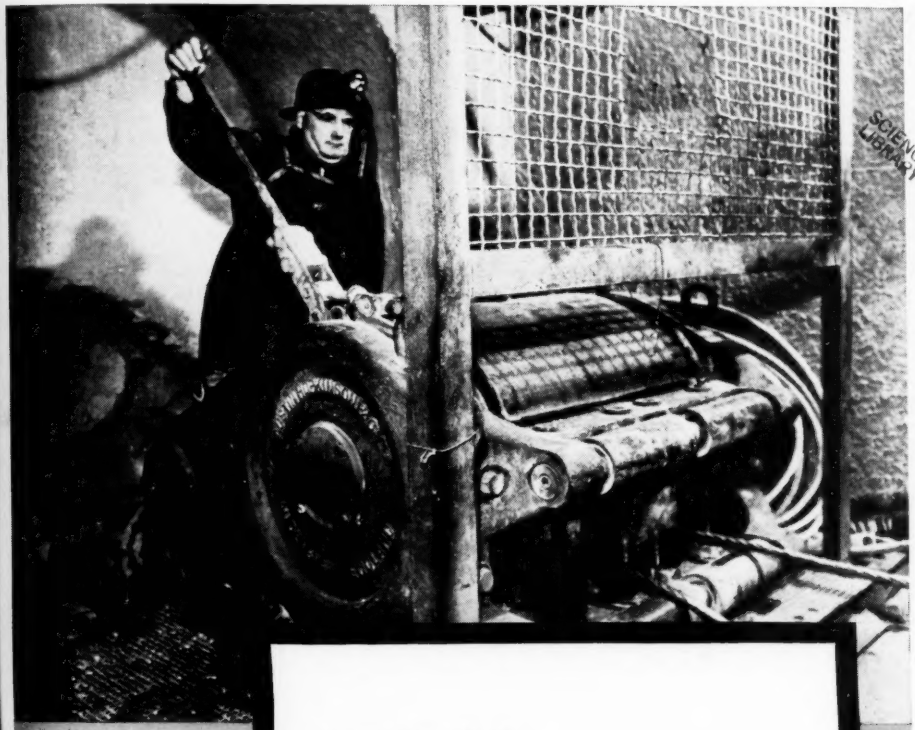

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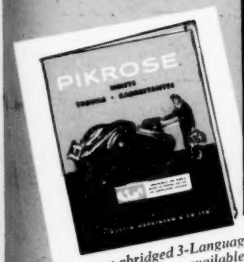

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EDITORIAL

EVIDENCE of the continued growth of the steel industry in South Africa may be found in the fact that last month a blast-furnace costing £3,500,000, the largest in Africa, was opened at the ISCOR Works, Pretoria, by the chairman, Dr. F. Meyer. The new furnace, which is 225 ft. high and took two and a half years to complete, incorporates the latest features of design and most of the equipment provided was made in the Union. The installation in Pretoria consists, in addition to the blast-furnace plant, of an electrostatic gas-cleaning plant, a boiler plant, and steam-driven turbo blowers. Its production will be 10,000 tons a week which is almost as much as the total output of ISCOR's other three furnaces.

RADIATION dangers to workers in uranium mines are discussed in a recent paper.[1] According to a study survey carried out for the Public Health Service it is believed that more than half the uranium properties in the United States have atmospheric concentrations of radioactive contaminants that are far above the levels considered "reasonably safe for industrial exposures." The Bureau warns that extensive mechanical-ventilation and dust-control measures are necessary to reduce such pollutions. Additional precautions recommended are frequent baths and clothing changes for all underground workers and annual medical examinations, while eating and storing of food in uranium mines should not be permitted. The principal uranium-producing states have adopted rules and regulations to cope with the major hazards and the Bureau report urges all concerned with uranium mining to be familiar with such measures and comply with them. The chief source of radiation is, of course, radon, the heavy gas emitted from the ore and water seepages.

Russia and Tin Restriction

Elsewhere in this issue our correspondent in Singapore mentions the opposition which has been voiced in Malayan mining circles to the admission of Russia to the International Tin Council as "an observer member." It is interesting, therefore, to note a current Washington report to the effect that Russia's decision not to become a full member of the International Tin Agreement is "not necessarily irrevocable" according to the commercial counsellor at the Soviet Embassy, Mr. V. S. Alkhimov, in reply to a question.

On this subject Mr. Clifford Waite, addressing the shareholders at the recent annual general meeting of Consolidated Tin Smelters, referred to the fact that the chairman of the Council had received a letter from the Government of the U.S.S.R. in reply to his invitation to that country to become a member of the International Tin Council. In their reply the Government of the U.S.S.R. advised that the question is under consideration but in the meantime suggested that they should be allowed to send an observer to the meetings. As to this Mr. Waite said: "In my opinion this proposal should be rejected by the International Tin Council. The U.S.S.R. have no doubt carefully studied the International Tin Agreement itself, which makes no provision for any country to attend the Council as an observer but makes it clear that all members of the Council must participate fully either as producers or consumers. Furthermore the U.S.S.R. were represented by an observer in the discussions and at the drafting of the International Tin Agreement at the United Nations Conference on Tin at Geneva in 1953, which was attended by all members of the International Tin Study Group. I consider, therefore, that nothing would be achieved by the International Tin Council accepting the U.S.S.R. as an observer and if, as the Government of the U.S.S.R. have stated, they are anxious to help the under-developed countries, they should without hesitation apply to become a fully participating member. Any delay or action contrary to the spirit of the Agreement can only lead to the conclusion that the U.S.S.R. is not eager for the success of the Agreement and is, in fact, endeavouring to wreck it. Such action must in the long run cause serious unemployment and severe hardship in the six producing countries who have faithfully fulfilled their obligations under the International Tin Agreement."

[1] Information Circular No. 7384. U.S. Bureau of Mines.

Geological Survey in 1957

The report of the Geological Survey Board for 1957 to the Council for Scientific and Industrial Research is published in the usual "Summary of Progress." [1] After giving careful consideration to the needs of the Survey for the quinquennium to 1964 the Board envisages considerable increases in staff of all grades if the Survey and Museum are adequately to fulfil their duties to the public. While the main function of the Geological Survey is the production of up-to-date geological maps—and it is satisfactory that the area covered by primary and revision survey was greater than in recent years—it is still evident that more rapid progress is required, the Board says, in both primary and revision survey. The stocks and printing materials of the one-inch and quarter-inch geological maps were, it is recalled, destroyed by enemy action during the war and there are still heavy arrears in replacement. Considerable stocks of memoirs were also lost and more rapid progress should be made both in field survey and the publication of results.

Particular interest, it is thought, attaches to the deep-drilling programme being conducted by the Survey, which is yielding significant results, while attention is also drawn by the Board to the extent to which geophysical methods have continued to be employed in problems associated with the investigation of underground geological structures. Regional gravity surveys have been undertaken in East Anglia, while the airborne magnetometer survey commenced in 1955 has been continued over southern England and nearly 40,000 sq. miles of central, eastern, and southern England have now been covered. As was noted in the August issue the Survey has continued to act as geological consultant to the United Kingdom Atomic Energy Authority in relation to the discovery and evaluation of raw materials for atomic energy purposes. In this connexion a number of radiometric anomalies were revealed by the airborne geophysical surveys in Cornwall and these are being further investigated.

Further reference might well be made to work carried out by the Atomic Energy Division of the Survey which, it is noted, has co-operated with the Chemical Research Laboratory in developing a new colorimetric method of determining small amounts of uranium in natural waters particularly suitable for primary geochemical surveys, as the test can be made on the river bank. Over 150 detailed mineralogical reports have been prepared during the year, it is stated, and some noteworthy discoveries have been made. Brannerite has been recognized in ore from the Kansanshi mine, Northern Rhodesia, while the presence of coffinite has been confirmed in ore from Buller Gorge, New Zealand, and a radioactive hydrocarbon identified in material from the same locality. A similar hydrocarbon was found at Wheal Speed in Cornwall, where highly radioactive anglesite, with activity presumably due to radium, was also discovered in the locality. A new thorium-rich variety of rhabdophane was discovered in specimens from Southern Rhodesia and uraninite was recorded from a number of localities in this territory and in Nyasaland. Progress has been made in the study of gadolinite, fergusonite, euxenite, and samarskite as part of a scheme to facilitate the identification of metamict minerals. Powder diffraction photographs of all available specimens are being prepared after standard heat treatment; X-ray fluorescence analysis techniques will also be applied to this problem. Further data have been accumulated on the reflectivity and micro-indentation hardness of ore minerals, more than 70 minerals having been examined. This technique was demonstrated at the Royal Society's Annual Conversazione and at the 150th anniversary celebrations of the Geological Society of London, while an opportunity for members of the Institution of Mining and Metallurgy to see it at work will occur in connexion with next month's symposium on the future of non-ferrous mining in Great Britain and Ireland.

[1] London: H.M. Stationery Office. Price 5s.

Technical Education on the Copperbelt

It was in the latter half of 1955 that the mining industry in Northern Rhodesia, alarmed at the lack of adequate technical education facilities in the mining area, established the Copperbelt Technical Foundation to provide for the training of local youth. For the purpose it was envisaged that a series of technological institutions should be set up in leading centres at an estimated initial cost, it was thought, of £400,000, to be contributed by the major operating companies.

Last month saw the official opening of the Kitwe centre and headquarters of the Foundation by the Hon. J. M. Greenfield, Federal Minister of Education, who, in his speech for the occasion, expressed the Government's thanks to the copper companies for their munificence and congratulated the Foundation on the fruition of its plans. The Kitwe centre is the fourth set of buildings to be opened by the Foundation and the Minister rightly commended all those responsible for the idea on the success that had already been achieved.

Speaking in reply to the Minister, Mr. O. B. Bennett, general manager of the Rhokana Corporation and chairman of the local committee of the Foundation, suggested that the extraordinary growth of the Foundation since it commenced active operation in January, 1957, was in itself a testimony to the need which has been met. Enrolment in March, 1957, totalled 420 students, of whom 327 were apprentices, over 23% of them being from outside the mining industry. At that time a further 93 adults were taking courses in eight different subjects and at the end of the year, some nine months later, the total enrolment was 832, made up of 364 apprentices and 468 adults taking some 16 different subjects. By March, 1958, after the Foundation had only been operating for a year, Mr. Bennett said, and when they had only just moved into their new premises on the other mines, the total enrolment was 1,023 and the range of subjects taken had increased to 26. He went on to make a strong appeal for support in the shape of interest and helpful co-operation in the many and expanding activities of the Foundation but more particularly for financial aid. The Foundation was generously endowed but most of the initial grants, Mr. Bennett said, had been spent on buildings, equipment, housing, and recruiting and on maintaining the best possible staff. The Kitwe Centre alone had cost £65,000 excluding equipment and there was therefore little left to provide a steady income to bridge the gap between receipt and expenditure despite Government assistance towards the technical training afforded. The gap, although not immediately vital, was still there and could not but have an effect on the future running and expansion of the Foundation. Mr. Bennett appealed to all to help in the training and education of the future citizens of the Federation and of the Copperbelt—the mining industry's potential employees.

Mining in Western Australia

During 1957 the gold mines of Western Australia treated 2,951,011 long tons of ore and recovered 849,751 fine oz. of gold, valued at £A13,277,354. These figures show an increase in tonnage of 80,738 as compared with the previous year and an increase of 36,234 oz. of fine gold; the gold recovered per ton was 5·76 dwt. against 5·67 dwt. for the previous year. Although in the period there were few opportunities of selling gold at a profit the Gold Producers' Association made four distributions amounting to £23,226, bringing the total amount distributed to members of the Association since its formation to £1,875,719.

The figures given here are abstracted from the report of the proceedings at the annual general meeting of the Chamber of Mines of Western Australia held in Kalgoorlie on May 27 last. In his address on the occasion Mr. R. J. Agnew, the president, said that during the year representations were made to the Federal Government for an increase in the subsidy received by marginal mines and, as a result, an increase was granted in the last Budget of 15s., which brought the maximum amount of subsidy to which such mines could become entitled to £2 15s. per fine oz.; at the same time the maximum amount allowed to be charged against development in assessing costs per oz. was increased from £3 10s. to £5 5s. Mr. Agnew went on to say that another matter which had been the subject of a further approach to the Federal Treasury was that of the 10% of capital being applied as a limitation on the total amount of subsidy payable. This might, he said, operate satisfactorily in the case of companies formed during recent years, but penalized older companies whose capital employed in the business is out of all proportion to the amount of capital on which the amount of the subsidy is calculated when the 10% limitation becomes operative. Such limitation could under certain conditions, Mr. Agnew said, be the means of depriving companies of badly-needed assistance which, if withheld, might be driven into the category of marginal mines where the problem of survival would become much more difficult. It is hoped that the Federal Government will examine this point and remove or at least ease to some extent this limitation on the total amount of subsidy payable.

MONTHLY REVIEW

Introduction.—Continued uneasiness over the political implications of the unsettled conditions in the Middle East and China naturally affects business sentiment, already aware of the current recession in industrial activity. In the metal market there is keen interest in the London talks between representatives of base-metal producers and hope that the meeting may well clarify the outlook for copper as well as for lead and zinc.

Transvaal.—The output of the Rand mines for July has been given as 1,456,925 oz., making with 42,312 oz. from outside producers a total of 1,499,237 oz. for the month. At July 31 there were 336,356 natives at work in the gold mines, as compared with 334,882 at the end of June.

Earlier this month shareholders of HARTEBEESTFONTEIN GOLD MINING were informed that the Vaal Reef had been cut in the 2A sub-vertical shaft, values at the point of intersection being reported as moderate. At 6,256 ft. below the surface the reef, sampled at 5-ft. intervals, averaged 5·65 dwt. gold and 0·521 lb. of uranium oxide per ton over a channel width of 34·5 in., equal to 195 in.-dwt. for gold and 17·98 in.-lb. for uranium. The reef, which was exposed on the elevation of No. 28 station, dips shallowly at 4° towards the west.

At an extraordinary meeting of WEST WITWATERSRAND AREAS, LTD., to be held later this month it is to be proposed that the capital of the company be increased to £1,085,624 by the creation of 1,484,992 new 2s. 6d. shares and that the directors be authorized to proceed with the acquisition from NEW CONSOLIDATED GOLD FIELDS and the other shareholders of NEW CONSOLIDATED FREE STATE EXPLORATION their shareholdings in that company, on the basis of two West Witwatersrand shares and 10s. in cash for every five shares of the Free State Exploration Co. The issued capital of this company is 3,712,500 shares of 5s. each and its assets at June 30 were 1,247,564 HARMONY and 1,931,050 shares and 11,490 1965 notes in FREE STATE SAAIPLAAS, cash of £196,510, mineral rights, and freehold property with a book value of £286,246. In a circular to shareholders accompanying the notice of the meeting it is suggested that the dividend revenue to be received from present investments may be expected to increase and will be augmented in the next few years by the increasing dividend revenue which it can be contemplated will accrue *via* New Consolidated's holdings in Harmony and Free State Saaiplaas. It is thought, indeed, that some further increase in the rate of annual dividend distributions by the company is likely to be feasible.

Last month TWEEFONTEIN UNITED COLLIERIES announced that it had decided that because of the unsuccessful tender to supply coal to the new Komati Power Station in the Eastern Transvaal, and that as present conditions are unpropitious for the exploitation of its relevant coal holdings, the cash resources are more than adequate for current requirements. Accordingly it proposes to repay the total preference share capital of £150,000 in £1 shares. This will be effected by the year-end when an additional special dividend of 4s. or 20% will also be paid on these shares.

TAVISTOCK AND UITSPAN COLLIERIES, which at present are not mechanized, will adopt mechanization to a degree dependent on the labour supply, which is now good, and on the extent of any increase in the coal price. The likely costs have not been determined; they would be expensive and an annual appropriation would have to be made for its eventual adoption.

Northern Rhodesia.—In the June quarter ROAN ANTELOPE COPPER MINES produced 19,716 long tons of copper, bringing the output for the year to that date up to 79,931 tons. The estimated profit for the quarter, subject to taxation, is given as £529,000 and that for the full year as £1,972,000, which may be compared with £7,268,000 for the previous year.

In the year to June 30 last MUFULIRA COPPER MINES produced 88,847 long tons of copper and CHIBULUMA MINES 27,210 tons. Mufulira's profit was £3,690,000 and Chibuluma's £993,000. The accounts of RHODESIAN SELECTION TRUST for the year show a profit of £2,882,000, subject to taxation, which compares with £7,416,000 for the previous year.

Ghana.—Speaking at the annual general meeting of BREMANG GOLD DREDGING held in London last month the chairman, Mr. C. J. Burns, announced that the Ghana Government had given the company a loan of £150,000 free of interest for a period of two

years from July, 1958, to August, 1960, and thereafter repayment over five years (1960 to 1965). During the repayment period the interest charged is to be 2½%. Mr. Burns went on to say that a Canadian mining expert, Mr. Monture, is at present visiting the gold mines in Ghana on behalf of the Government with a view to drawing up new legislation subsidising the marginal mines. The Ghana Government had wisely decided, said Mr. Burns, that it was neither in the best interest of the gold mines nor of the Government to grant subsidies on an *ad hoc* basis, "preferring legislation on the lines of the subsidies granted by the Canadian and Australian governments." It was confidently expected that should Bremang qualify for assistance under any new legislation which may be enacted then the amount of subsidy agreed to be paid would be deducted from future repayments under the loan agreement. Shareholders were further informed that the move of No. 3 dredge was proceeding and that arrangements were being made to transfer the company's main camp from Hiawa to Dunkwa in order to economize on the cost of dredge maintenance and repair.

Nigeria.—UNITED TIN AREAS OF NIGERIA reports an output of 65 tons of tin concentrates and 5 tons of columbite for the year to March 31 last. Operations resulted in a loss of £11,895. In his review accompanying the report and accounts for the year the chairman refers to a tin ore occurrence in a mineralized dyke discovered on the Odegi Leases, in which the company holds a two-thirds interest. The occurrence is being tested for its immediate potentialities by means of diamond-drill holes and production in a small way has been already won by means of open-cast methods from ore containing 2% tin. The indications at present are, it is thought, that this may be an important discovery, but much work remains to be done to establish the commercial possibilities of the new find.

The operations of RIBON VALLEY (NIGERIA) TINFIELDS for the year to March 31 last resulted in a profit of £5,786, £1,883 of the sum available being required for a dividend equal to 2½%. In the year 223 tons of tin concentrates and 2·68 tons of columbite were recovered.

Tanganyika.—On August 13 the Tanganyika Government and DE BEERS CONSOLIDATED MINES signed an agreement to make them equal partners in the Williamson diamond mines at Mwadui, the purchase price being £4,140,000 *plus* death duties. The Tanganyika Government is to bring a Bill before the Legislative Council to enable it to accept 320 shares for estate duty and to purchase another 280 shares from De Beers for £1,317,000, the money to be paid over 20 years out of dividends from the shares. The Government and De Beers will hold an equal number of shares and each will have four directors on the board. In a circular issued earlier this month on behalf of De Beers Consolidated it is pointed out that the acquisition required foreign exchange and the company earlier applied to the South African Reserve Bank for it. The application was granted but at the same time the South African Treasury and Reserve Bank asked for an undertaking that every effort would be made to raise an equal sum of money abroad. At the time preliminary discussions were taking place between ANGLO AMERICAN CORPORATION OF SOUTH AFRICA and the Deutsche Bank A.G. regarding the introduction of ordinary shares of Anglo American Corporation on certain German stock exchanges and the possibility of the Corporation raising a loan in Germany. Negotiations between the Corporation and the Bank have now been concluded and an agreement is shortly to be signed whereby the Bank will make a loan to the Corporation of 50,000,000 Deutsche Marks (approximately £4,262,000 South African currency at the present rate of exchange).

Australia.—It was announced last month that the Commonwealth Government has decided to stockpile beryl. Arrangements are being made for the purchase of beryl ores and concentrates from producers within Australia and for the present the price is to be equal to that which is currently being paid. The programme for stockpiling is to be reviewed from time to time when both the price and the possibilities of allowing some exports will be taken into consideration in fixing arrangements.

The Minister for National Development said last month that negotiations had been completed for the sale to the United Kingdom Atomic Energy Authority of uranium concentrates to be produced from the South Alligator River area of the Northern Territory. At the same time agreement had been reached between the Commonwealth Government, the United Kingdom Government, and the uranium mining companies operating in the South Alligator River for the sale of a

substantial quantity of uranium oxide. Contracts would provide for the sale of uranium oxide to a total value of over £6,000,000.

It has been stated in London earlier this month that the official opening of the Mary Kathleen uranium mine in Queensland will take place on October 27. The Prime Minister of Australia, the Rt. Hon. R. G. Menzies, has accepted the invitation of the chairman and directors of the RIO TINTO MINING CO. OF AUSTRALIA PTY. to visit Mary Kathleen and to declare open the uranium mine, mill, and town.

The directors of MOUNT MORGAN announced last month that subject to completion of the audit the net profit for the year ended June 29, 1958, is £259,771, after providing £100,000 for depreciation.

The WESTERN MINING CORPORATION reports a profit of £A259,970 for the year ended March 31 last, dividends equal to 1s. a share requiring £A187,862 of the £A1,062,461 available. The consolidated profit of the company and its subsidiaries was £A666,857, of which £A352,863 was attributable to the company from its own profits and its interests in the profits of subsidiary companies and £A313,994 was attributable to the interests of minority shareholders in the subsidiary companies.

New Guinea.—Earlier this month shareholders of NEW GUINEA GOLDFIELDS were informed that the company has been investigating ground covered by an option which it has secured in the Edie Creek area. A small occurrence of high values has been revealed but its extent is as yet unknown.

Fiji.—A recent announcement by the directors of EMPEROR MINES states that the Fiji Government has agreed to grant a subsidy on the gold production of its operating company EMPEROR GOLD MINING. The subsidy, which will run for three years from June 19, 1958, is to be paid at the rate of £2 (Fijian) per oz. of gold and to a maximum of £150,000 (Fijian) annually. A condition of the subsidy is to be that the company will be subject to Fijian Income Taxation and Royalty Levies.

Malaya.—In a statement recently issued the directors of MALAYAN TIN DREDGING and KRAMAT PULAI announced that they had agreed terms for an offer by Malayan Tin to the Kramat Pulai shareholders for the 314,667 shares of 3d. each not already held by Malayan Tin. Subject to obtaining Treasury consent Malayan Tin is to offer 1s. 6d. in cash for each share in Kramat Pulai *plus* the allotment of one share of 5s. fully-paid in Malayan Tin for every three shares in Kramat Pulai.

India.—The accounts of the INDIAN COPPER CORPORATION for 1957 show a profit of £1,123,749 and a total of £1,254,729 available. Of this amount a dividend equal to 18% free of tax required £246,834. In the year the mill treated 440,671 short tons of ore and recovered 35,674 tons of concentrates. At the refinery 7,848 long tons of refined copper was produced. Ore reserves at the end of the year were estimated as 3,850,757 short tons averaging 2·5% copper over a stoping width of 78 in.

Colombia.—In the three months to June 30 last PATO CONSOLIDATED GOLD DREDGING dredged 5,864,000 cu. yd. of ground and recovered 38,707 oz. of gold. The net profit for the six months ended June 30, subject to audit, is estimated at $800,000. Production for the first half of the current year, it is stated, is higher than estimated since Dredge No. 4 has been recovering excellent values in a narrow stretch of the river through which it was necessary to pass on its flotation course to its assigned reserves some 10 miles down river. It had previously been considered impractical to dredge this part of the river, but such has proved not to be the case. This improved production will not continue during the second half of the year, it is pointed out, as No. 4 dredge will be digging flotation tailings and No. 5 dredge will be out of production for several months while undergoing extensive repairs and reconstruction.

Canada.—At the end of August MILLIKEN LAKE URANIUM MINES, managed by the RIO TINTO Group, announced that its 3,000 ton per day mining property in Algoma, Ontario, is now up to full tonnage with output for August to date averaging 3,240 tons of ore per day. The Milliken shafts were completed last December and the mill commenced operation during the first week of April. During July 88,179 tons of ore was treated averaging 2,844 tons per day and yielded a gross production of $1,457,000. The mill has operated satisfactorily, it is stated, and achieves an average recovery of 93·25%. Milliken Lake holds a contract for the sale of $94,525,000 worth of uranium oxide to ELDORADO MINING AND REFINING.

Portugal.—With the recent dividend announcement shareholders of BERALT TIN AND WOLFRAM were informed that the profit for the year to March 31 last was £218,328,

the accounts showing £524,158 for appropriation. Dividends equal to 90%, including the 40% special dividend already declared, require £171,293. It is stated that by far the greater part of the profit for the year accrued from the fixed price contract with the U.S. Government which expired at the end of September, 1957. Owing to the continued fall in the price of wolfram little or no profit was earned during the latter half of the year. Since then the position has deteriorated as a result of a further fall of about 30s. per unit in the price.

Norway.—On August 25 it was announced in Oslo that a long-term contract had been signed between ALUMINIUM UNION, a subsidiary of ALUMINIUM, LTD., and A/S AARDAL OG SUNNDAL VERK concerning supply of the works' main raw material, alumina, against payment in aluminium metal. It is expected that the bulk of this alumina will be provided from the Aluminium, Ltd., alumina works in Jamaica, West Indies. The contract covers the delivery of a quantity of about 4,000,000 metric tons of alumina worth about 2,000,000,000 Norwegian Kroner based on to-day's prices. The agreement covers a substantial part of the alumina requirements of Aardal og Sunndal Verk up to 1978.

United Kingdom.—Reference to the results of the operations of GEEVOR TIN MINES in the year to March 31 last was made in the August issue. The report now available shows that in the year 63,829 tons of ore was milled and 683 tons of black tin recovered. Ore reserves at March 31 last are given as 190,533 tons, including 5,000 tons broken in the stopes.

The report of TEHIDY MINERALS, LTD., for 1957 shows a profit of £8,148 and an available credit of £27,334. Of this amount £7,396 is required for dividends equal to 17½%, leaving £19,948 to be carried forward.

British Tin Investment Corporation.—The accounts of the British Tin Investment Corporation for 1957 show a net revenue of £291,808 and £427,529 available, of which £423,648 has been distributed as dividends equal to 35%.

Consolidated Tin Smelters.—The report of Consolidated Tin Smelters for the year ended March 31 last shows that of the consolidated net profit of £531,219, the holding company retained £401,333, the accounts showing £628,878 available for distribution. Of this amount £50,694 is required for preference dividends and £201,096 for a dividend and bonus totalling 9d. a stock unit, while £50,000 has been provided for depreciation, and £100,000 placed to reserve, leaving £227,088 to be carried forward. The report states that the smelting plant in Penang has been redesigned to permit of additional internal mechanical handling. These alterations are now complete and the planned economies are yielding results.

DIVIDENDS DECLARED

* Interim † Final

(Less Tax unless otherwise stated.)

†**Anglo-Huronian, Ltd.**—25 cents, payable August 20.

†**Beralt Tin and Wolfram.**—50%

***British South Africa Co.**—1s. 3d., payable Oct. 10.

***Central Provinces Manganese Ore Co.**—1s. 2d., free of tax, payable Oct. 1.

†**Clutha River Gold Dredging.**—5%, payable Oct. 6.

***El Oro Mining and Exploration.**—5%, payable Oct. 31.

***Exploration Co.**—5%, payable Oct. 31.

†**Free State Geduld.**—3s., payable Nov. 6.

***Kundang Tin Dredging.**—3s., payable Sept. 17.

†**Lydenburg Estates.**—3d., payable Oct. 14.

†**Mount Lyell Mining and Railway Co.**—1s. 3d. Aust., payable Oct. 25

†**Mount Morgan.**—1s. Aust., payable Sept. 30.

†**President Brand Gold Mining.**—2s. 6d., payable Nov. 6.

†**President Steyn Gold Mining.**—1s. 3d., payable Nov. 6.

†**Southern Tronoh Tin Dredging.**—6d., payable Nov. 5.

†**Transvaal and Delagoa Bay Investment Co.**—7s., payable Sept. 22.

†**Tronoh Mines.**—6d. and 6d. bonus, payable Nov. 7.

†**Welkom Gold Mining.**—3d., payable Nov. 6.

†**Western Holdings.**—4s., payable Nov. 6.

†**Witbank Colliery.**—4s., payable Sept. 25.

METAL PRICES

Sept. 9.

Aluminium, Antimony, and Nickel per long ton; Chromium per lb.; Platinum per standard oz.; Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home)	180	0	0
Antimony (Eng. 99%)	190	0	0
Chromium (98–99%)		7	2
Nickel (Home)	600	0	0
Platinum (Refined)	23	5	0
Silver		6	4
Gold	12	10	8
Wolfram (U.K.)		—	
(World)	3	2	6

Tin, Copper, Lead, Zinc } See Table, p. 176.

Geology at Geneva

A report on the United Nations Conference

C. F. Davidson [1]

Introduction

For the last two weeks the Second United Nations International Conference on the Peaceful Uses of Atomic Energy has been sitting in Geneva, where around 2,250 scientific papers were placed before an assembly of more than 5,000 Government delegates, advisers, and invited observers. The programme of the Conference called for some 80 separate sessions, of which six were concerned with various aspects of the geology, mineralogy, mining, and extraction metallurgy of the raw materials of atomic energy. In this brief review an attempt is made to summarize some of the principal contributions submitted to the geological meetings.

The international character of the geological discussions was somewhat more pronounced than at the first Conference three years ago. In 1955 the United States contributed 85 out of the 125 papers on geology and prospecting, the remaining 40 works coming from 23 different countries. In 1958 the American contribution was 36 papers from a total of 113, with 12 from France, 11 from India, nine from Argentina, eight from U.S.S.R., six from Canada, and the remainder from a dozen other countries. No papers were submitted from Australia, New Zealand, the Central African Federation, or the British Colonies; nor were any works forthcoming from East Germany, Czechoslovakia, and Bulgaria, despite the intensive mining operations undertaken in these latter countries to exploit the lode and other deposits associated with the Hercynian granites. The U.S.S.R.'s contributions were disappointing and, to judge from recent publications in the Russian language, quite failed to do justice to the radio-geological activities in the Soviet Union.

The Proceedings of the Conference will be published by United Nations in 34 volumes, to be completed by June, 1959, two of these being concerned with aspects of geology, mining, and extraction metallurgy. The pre-publication price is £155.

[1] Professor of Geology in the University of St. Andrews.

World Resources of Nuclear Fuel

The sessions on raw materials opened with leading papers from the U.S. Atomic Energy Commission, presenting an appraisal of world resources of nuclear fuel (excluding the potentiality of the Communist countries) and reviewing the geological distribution of these ores. Since the first U.N.O. Conference in Geneva in 1955, no new great ore fields have been discovered—a circumstance no doubt attributable to the limited market for additional uranium production; but assessments which were largely inference three years ago have now been confirmed by exploration and development.

The potential resources can be divided into two main categories: Those from which uranium can be recovered in high-grade concentrate at \$10·00 a lb. of U_3O_8 or less and the very low-grade shale and phosphate deposits which, save when the uranium is recoverable as a by-product, demand a price of \$30·00 to \$60·00 a lb. before they can be regarded as economic. Reserves in an intermediate class, sub-marginal to the higher-grade deposits, are known less precisely but may in time become important.

Of the deposits in the first category approximately 400,000 tons of U_3O_8 is available in developed or partly developed ore in Canada and roughly the same figure in South Africa. Recorded reserves in the United States are now about 220,000 tons. France has published reserve figures of 50,000 tons to 100,000 tons. Taking into consideration the probable conservative nature of these estimates and including the reserves of Australia, Belgian Congo, Portugal, and other countries, it seems probable that the potentiality of the non-Communist territories in ore fields at present under development may be close to 1,500,000 tons U_3O_8. Ultimate production from these known deposits may reach 2,000,000 tons; and on

geological grounds there seems a reasonable expectation of finding an additional 2,000,000 tons of low-cost uranium "provided a vigorous exploration policy is maintained." Since the 1955 Geneva Conference there has been an increase in *developed* uranium resources amounting to a round million tons.

At the end of 1955 total uranium production of non-Communist countries was at an annual rate of 11,500 tons U_3O_8. To-day the rate is about 35,000 tons and in 1959 it should be 42,000 tons a year. The total annual value of uranium concentrate production in non-Communist countries is now around $750,000,000.

On the basis of present production costs, it is estimated that a price of $8·00 to $10·00 per lb. of U_3O_8 in mill concentrate should support an output rate in excess of 40,000 tons per year; and that from 1962, when most American mills will have been fully amortized, the U.S. domestic price of $8·00 guaranteed to 1966 will provide most American producers with a profitable market. In the wider world field, for the next ten to 15 years, a price in the range $8·00 to $10·00 should produce sufficient supplies to meet anticipated requirements; and only if there are needs substantially in excess of 40,000 tons per year will a higher price range be warranted, to encourage exploration, development, and mill construction. "Most estimates indicate a rapidly expanding market for uranium beginning about 1965."

With increased availability of high-grade resources, the prospects of developing low-grade shale and phosphate deposits are now remote, though these beds "constitute a vast uranium reserve which assures adequate supplies of nuclear fuel for many generations." Production costs from Chattanooga shale are budgetted at $40·00 to $50·00 per lb. if the rock were to be mined and processed for uranium alone—a price which would be somewhat reduced by the recovery of by-products. However, recovery of uranium from commercial phosphate operations has already proved successful, two American plants yielding uranium output as a by-product of phosphate fertilizer at a cost in the range $7·00 to $12·00 per lb. U_3O_8. Eventual by-production of uranium from the phosphate industry could be several thousand tons a year.

Economic reserves of thorium within non-Communist countries are estimated to be about 500,000 tons, mostly present in the beach placer deposits of India and in the uranium deposits of Blind River and Bancroft in Canada. The uranium ore reserves in these latter areas probably contain about 200,000 tons of thorium; and at an annual output of 10,000 tons U_3O_8 they could yield between 4,000 and 5,000 tons of by-product thorium annually—an amount many times the maximum output that the world has hitherto seen. This by-product thorium from Canadian uranium mills is likely to be the cheapest source of future supplies.

Canada

The resources of good-grade uranium ore in Canada are now well known to exceed those of any other country; but since there has of late been no restriction on publication in the Dominion, the half-dozen papers submitted to the Conference could say little new. The Geological Survey of Canada reported that estimated production of uranium oxide in 1957 totalled 6,687 tons, valued at $136,700,000. At the end of the year 15 mines having their own treatment plants were in operation, six smaller mines provided tribute ore, and treatment plants at four other mines were nearing completion. Three very different types of ore were mined. Uranium-bearing conglomerates in the Blind River region, Ontario, accounted for 51% of the Canadian production in 1957. Pitchblende-bearing veins and disseminations in the Beaverlodge region, Saskatchewan, and the Great Bear Lake and Marian River regions, N.W.T., provided 41%. Dykes and lenses of pegmatitic granite in the Bancroft region, Ontario, yielded 8%.

A summary of company data on Canadian

Table 1

Canadian Reserves of Uranium Ore

(*Short tons*)

Type	*Measured*	*Indicated*	*Inferred*	*Totals*
Conglomeratic . . .	31,300,000	279,200,000	45,200,000	355,700,000
Pegmatitic . . .	300,000	9,600,000	980,000	10,880,000
Veins and related deposits .	180,000	10,100,000	28,000	10,308,000
Totals	31,780,000	298,900,000	46,208,000	376,888,000

reserves of uranium is given in Table 1. The tenor of the conglomeratic and pegmatitic ores is about 0·1% U_3O_8, whilst the veins and stockworks are mined at 0·2% to 0·5%, most ore averaging 0·2% U_3O_8. "Ore" is defined as "mineral substance expected to be mineable at present at a profit to the operator." This definition thus excludes great reserves of uranium-bearing material in deposits too low in grade or too small to be worked economically to-day.

In 1958 the plant capacity in the Blind River area will total 35,000 tons per day or 12,775,000 tons per year. At this rate of production the known reserves in the Blind River mines will suffice to furnish ore for the next 20 years. In addition to uranium, these ores are estimated to contain an average of 0·05% thorium oxide and as noted above form one of the world's principal sources of thorium potentially available as a by-product.

The French Union

A group of a dozen papers presented by geologists of the Commissariat à l'Energie Atomique furnished one of the most solid and valuable contributions of the Conference. In no other European country has quite the same success attended exploration within the last decade as in France. To-day seven main deposits, all of hydrothermal lode type, are being exploited in the three regions of the Limousin, the Forez, and the Vendée; and an eighth occurrence, in the uranium-bearing shales of the Vosges, is scheduled for open-cast working. Other recent discoveries in Metropolitan France, mainly in the Alps and the Pyrenees, have opened up new avenues for prospecting.

The lode deposits all occur in Hercynian granite, those in the Limousin occupying cross-fractures in lamprophyre and micro-granite dykes within the granite. The mineralization is pitchblende (usually as microspherulites in quartz or jasper) or sooty pitchblende ("uranium black") associated with pyrites, marcasite, chalcopyrite, and galena. The Limousin has been the most noteworthy uranium area in France since the first workable deposit (the Henriette mine at La Crouzille—now a quarry) was discovered a decade ago. To-day there are three main groups of deposits—Margnac, Fanay-les-Sagnes, and les Brugeauds. The Margnac group consists of four N.–W. veins, soon to be equipped with a main extraction shaft to *minus* 350 metres. Fanay-les-Sagnes comprises two deposits along the same N.W.-trending structure, 2 km. in length, with mineralized sections up to 500 metres. Les Brugeauds comprises a group of three deposits workable as a unit, two of them with stockworks up to several thousand square metres in section, largely workable by open-casting. Very rich ore occurs locally, but the run of the mine is maintained at 0·16% to 0·19% over 1·5 metres.

The Forez deposits in the granite horst east of Clermont Ferrand include the mine of Bois Noirs, at present the most important individual occurrence in France. Here a complex fault zone in granite, with quartz-pitchblende-pyrite-galena mineralization usually 1 metre to 3 metres in width but at times as much as 25 metres, yields an ore averaging about 0·28% grade, mineralization being developed along a strike of 700 metres to 800 metres. The mine has five levels to *minus* 200 metres and a second shaft to *minus* 400 metres is now being sunk.

Although the Vendée deposits near Nantes are relatively new discoveries, exploration here is already more advanced than elsewhere. Three major occurrences are known—la Chapelle Largeau, la Commanderie, and l'Escarpière—all occurring at the convergence of N.W.–S.E. and N.–S. veins in the granite batholith. The veins bear brecciated infillings of quartz, chalcedony, and fluorite, with microspherulites of pitchblende and pyrite (or "uranium black" with melnikovite) and they are characterized by a virtual absence of other sulphides. At the Escarpière site, where development is beginning on *minus* 160 and *minus* 200 metre levels, the mineralization is patchy but selective mining yields an average grade between 0·6% and 0·9%.

The deposits of Schaentzel, Teufelsloch, and elsewhere in the Vosges are of quite a different character. They consist of uranium-bearing carbonaceous shales occurring with coals and sandstones in small basins of Westphalian strata, down-faulted into the granite-gneiss basement and locally covered by Permo-Trias red beds. The mineralization is highly erratic but is confined to the black shales; and the phase distribution of the uranium is not known, though there is a preferential association with organic matter in the shales. In the higher grade strata mispickel, blende, and galena are present. The overall mineralized area is around 25,000 square metres, the thickness of potential ore from 1 metre to 40 metres, and the grade in

the range 0·02% to 1·0% (exceptionally 10·0%), averaging around 0·16%. These unique deposits, which are ready for open-cast working, are of much higher and more erratic tenor than uraniferous shales of undoubted syngenetic character and whilst the origin of the mineralization remains debatable statistical distribution studies are believed to favour a hydrothermal derivation.

In the French Territories Overseas, explorations have been less successful than at home. Beach placers with monazite, ilmenite, and zircon have been discovered in south-eastern Madagascar, where they are being worked; and a great many little deposits of uranothorianite, forming amoeboid dispersions in parapyroxenite, are present in the same general region. At Mounana in French Equatorial Africa laterite-capped sandstones mineralized with uranium-barium vanadates, pitchblende, sulphides, and in particular with vanadium oxide minerals, have been explored by diamond drilling since 1957. This disseminated mineralization is reminiscent of that of the Colorado Plateau and both from a scientific and economic aspect the ore-body would seem to be of unusual interest.

The current production of uranium in France is estimated at 550 tons in 1958 and is expected to rise to 1,000 tons by 1960 and 1,500 tons by 1962. Known reserves will suffice for the next ten years. If studies in progress confirm the importance of the Mounana deposit in Gabon, an additional annual output of 300 tons will be forthcoming from that source by 1961. French production of thorium, a by-product of uranium extraction from the thorianite of Madagascar, amounts to 250 tons to 300 tons (metal content) in thorium nitrate annually and, it is claimed, makes France the greatest producer of thorium in the world. The known reserves, however, are insufficient for more than a few years of production.

Hungary

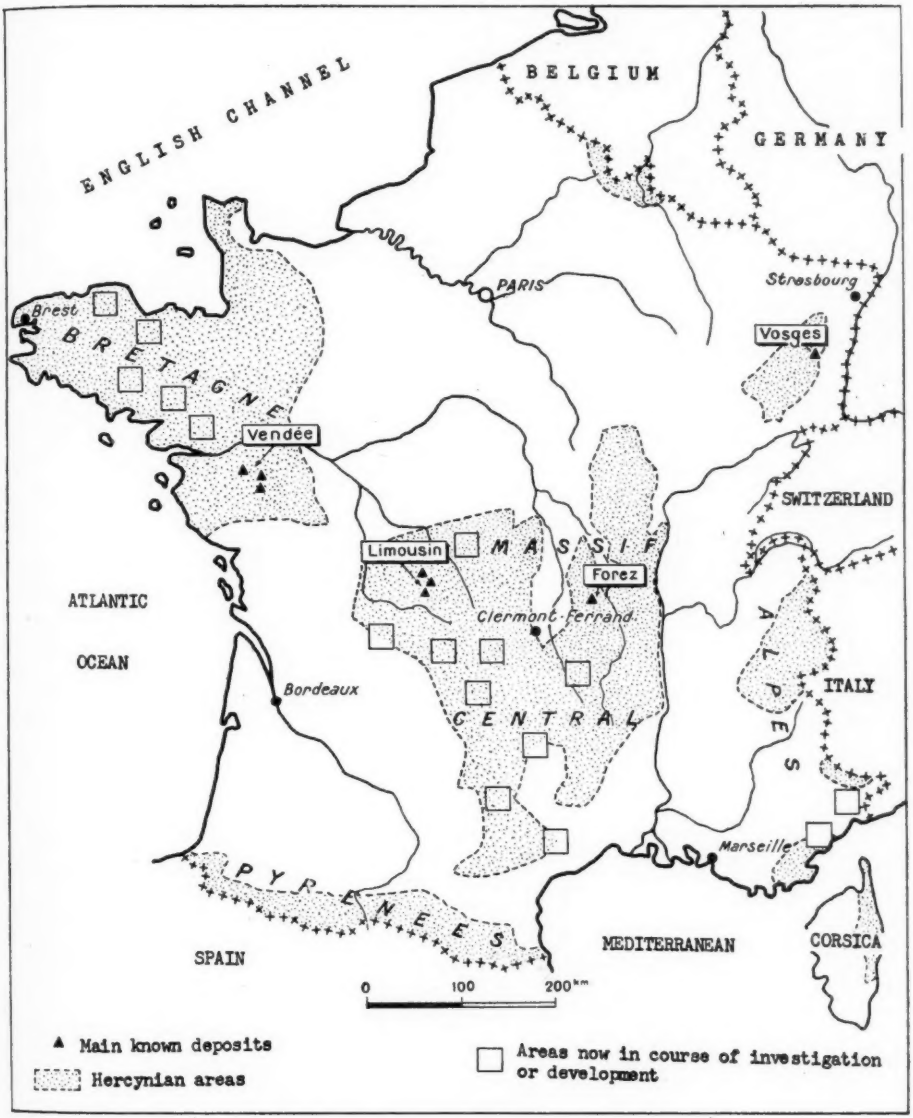
In the Mecsek mountains of Hungary an occurrence of disseminated uranium mineralization, seemingly of fair size, has been found in sandstones of Permian (Upper Rothliegend) age. In these strata there are lenticular and bedded dispersions of uraninite, pitchblende, and secondary saddyite, various other oxidized minerals present being of no economic significance. The uranium is accompanied by pyrite and by the sulphides of cobalt, nickel, lead, zinc, and copper, but in the uppermost uraniferous strata the cobalt, nickel, and lead are absent. Some of the mineralization is concentrated around plant remains; and in the richest zones there is a great development of alkali feldspars—orthoclase, microcline, and acid plagioclase—the sandstone taking on the character of an arkose. The ores differ from those of the Colorado Plateau in the presence of cobalt and nickel.

The origin of the deposit is somewhat unconvincingly ascribed by the Hungarian geologists to the accumulation in lacustrine basins of detrital uraninite and detrital sulphides derived from the denudation of nearby lodes, concomitantly with the accumulation in the same sediments of uranium and other heavy metals fixed by adsorption in the organic matter and in abundant sericite. The zoning of the mineralization in the sandstones and arkoses, with cobalt, nickel, and lead absent in the upper strata, is accepted as a reversal of the zoning in the primary hydrothermal deposits whence the ores were derived. As with all the papers from Communist countries, no indication is given of the grade of the ore or the extent of the deposit and explanatory maps are absent.

The Hungarian workers have not observed that, in the presence of very high quantities of orthoclase and other alkali feldspars, this deposit exhibits a common denominator with many other occurrences of disseminated uranium ores. In some of these the potash content much exceeds that which can be accounted for by the accumulation of detrital silicates. The key to a better understanding of these ore-bodies may well be found in the recognition that the ore formation is accompanied by alkali metasomatism on quite a large scale.

Japan

In 1956 the Atomic Fuel Corporation of Japan was established to prospect for and develop sources of radioactive ore and since then extensive explorations have been made using geochemical, chemicobotanical, and other fashionable techniques. The principal discoveries of ore pre-date the Corporation, however, and were due to the Geological Survey. The most significant find, made by a combination of aerial and car-borne radioactivity surveys and first located in a road-cutting late in 1955, is an extensive uraniferous conglomerate occurring at the base of lacustrine Tertiary (Neogene) sediments, at



Location of the Main Uraniferous Areas of France.

the locality Ningyo-toge in Tottori prefecture. The conglomerate averages about 2 metres thick, rests unconformably upon a granitic basement, and is succeeded by sandstones, arkoses, and tuffs. It is formed mainly of pebbles of igneous rock—granites, andesites, rhyolites—with an arkosic cement which contains organic matter and pyrite. The last two components are sympathetically accompanied by a finely-divided black uranium mineralization, one phase in which is an unidentified uranium phosphate which

alters to autunite associated with limonite in the oxidized ore. A little marcasite and sphalerite are also present. The ores are classified into (1) common ore, being the uraniferous conglomerate of widespread distribution; (2) black ore of high uranium content assaying 0·1% to 3·0% U_3O_8, which forms lenses in the common ore; and (3) oxidized ore—reddish-brown conglomerates above the water-table, in which the uranium content is low.

This conglomerate has been prospected by about 4,000 metres of drilling and 3,600 metres of driving and has unexpectedly been found to be of great size, extending intermittently for about 8 km. from east to west and 1 km. to 3 km. from north to south. The uranium content reputedly averages 0·05% throughout; and it is said that "the uranium reserves are roughly estimated at one million tons"—but manifestly this figure must refer not to uranium but to the uranium "ore" at 0·05%. The granite massif on which the conglomerate lies unconformably is accompanied by low-grade vein deposits of uranium, bearing coffinite and autunite. No opinion on the mode of genesis has been hazarded, but clearly the prospect is of unusual scientific interest.

Hazards of Radioactivity

Propaganda on the hazards of radioactivity, to which newspaper readers in Britain have lately been subjected, becomes somewhat less effective in the light of one brief paper by scientists of the Indian Atomic Energy Commission. This contribution, entitled "Radiation Dose Measurements in the Monazite Areas of Kerala State," explains quite simply that a population of 100,000 Indian fishermen inhabiting the coast of what used to be known as Travancore live, as their forefathers have done for generations, in an environment which is three times more radioactive than the level internationally agreed as the maximum permissible non-occupational dosage of radioactivity. The source of this radioactivity is the heavy-mineral sand on which the fishermen's houses are built—sand abnormally rich in monazite, zircon, and ilmenite. Field investigations by the writer of this review, undertaken in 1945, demonstrated the existence of at least a few hundred million tons of this sand averaging around 1% monazite (0·1% ThO_2).

Whilst it has long been known to a few geologists that the level of radioactivity in these Moslem villages much exceeded the accepted tolerance, nevertheless geneticists have been consistently sceptical of this conclusion. The quantitative assessment by Indian physicists is therefore welcome—though it may embarrass Mr. Nehru who, in the midst of his warnings on radioactivity hazards early last year, decried the possibility of there being any risk to the Travancorean fishermen "since their families have been living there for centuries." The common sense seems indisputable. These coastal villagers are tough, of better physique than most Indian peasants of the hinterland. It was they who defeated Tippu Sultan on his otherwise victorious sweep through India nearly two centuries ago. And in recent times they have fought for every square yard of their radioactive sand when mining companies wished to work their leases.

Coastal Kerala is not the only such radioactive high-spot on earth—there are similar though much less populated environments elsewhere in India, in Ceylon, Brazil, and elsewhere. The town of Rosetta in the Nile delta has a rather high radioactivity due to the black sands on which it is built. It may be that greater use should be made of geological information in assessing the level of radioactivity that man can safely endure. It may be that geneticists should pay more heed to human material and extrapolate less from their mice and fruit-flies. It may be that Indian politicians should say less about the present artificial radioactivity hazards when a much greater natural "hazard" affects 100,000 people within their own country.

(*To be continued.*)

Gold Find in Western Australia

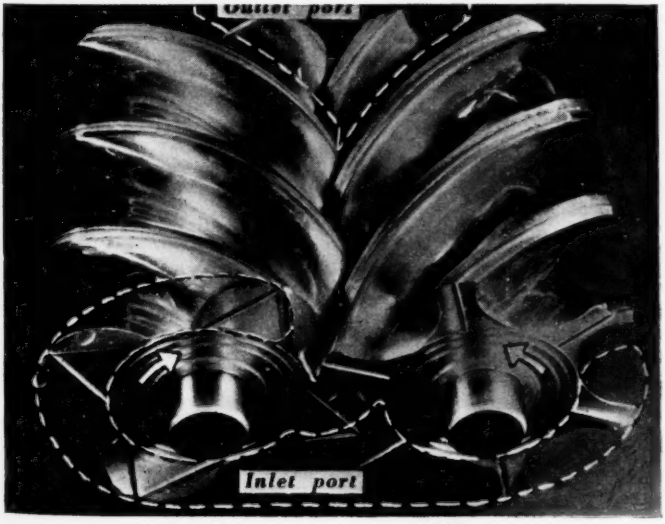
Most of the "back country" of Western Australia (the well-known goldfields) has been for some, or even many, years used also for pastoral areas. On one of these pastoral stations, "Wildara," aboriginals in search of the succulent "goanna" have discovered alluvial gold in some quantity, the story of which has created a certain amount of excitement at Leonora and to the north. Pieces and slugs of gold, some of quite appreciable size, have been forwarded to the Mint in Perth. The total value—to date—exceeds £1,000. The first find was got when one native reached down into a "scrape" or burrow.

Screw Compressor Installation at Kiruna

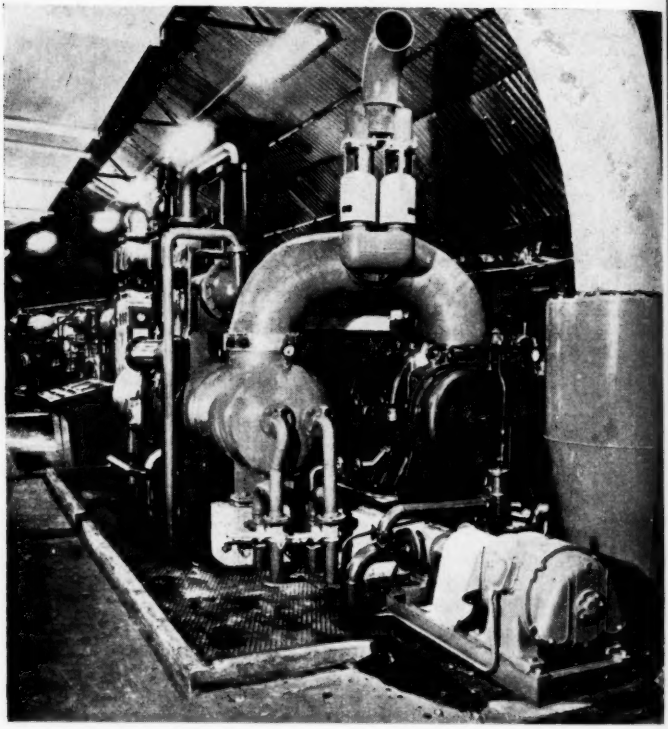
Notes on a recent installation and on screw compressors in general

Two screw compressors manufactured by Svenska Rotormaskiner A.B. have recently been installed at the Kiruna mine in Northern Sweden. These each have a capacity of 5,500 cu. ft. per min. of free air at a maximum pressure of 120 lb. per sq. in. and each is provided with a separate electric-motor driven lubricating-oil pump, the main drive being by a short-circuit induction motor which is started direct on line. This motor is rated at 1,340 h.p. at 2,970 r.p.m., the supply pressure being 3,000 V., 50 cycles. Each compressor incorporates separate low-pressure and high-pressure stages, coupled to a common motor with shaft extensions at each end and Fig. 1 shows a sketch of the installation while Fig. 2 shows the compressor plant underground. Intake air is taken through inlet pipes to the low-pressure stage, passing then through an intercooler located at the side of the compressor and thence to the high-pressure stage and an aftercooler. Cooling water is obtained from a cooling tower located 50 ft. above the compressor house. Some mine water is supplied to the plant and this is taken through the last element of the aftercooler. The compressor can operate either on full load or no load, unloading taking place by opening the discharge to atmosphere and simultaneously choking the inlet pipe. When unloaded the compressor operates between pressure limits of about 1·4 lb./sq. in. and 14 lb./sq. in. abs.

For a machine of this size certain protection devices are required which will stop the machine should a fault occur anywhere in the plant. At the Kiruna mine equipment is incorporated to protect the plant from the results of low lubricating-oil pressure, failure of the lubricating-oil pump, failure of the cooling-water pump, excessive air temperatures at h.p. suction or delivery, and electrical overload protection. Should a fault arise in any of these control devices the compressor motor stops and the indicator board shows

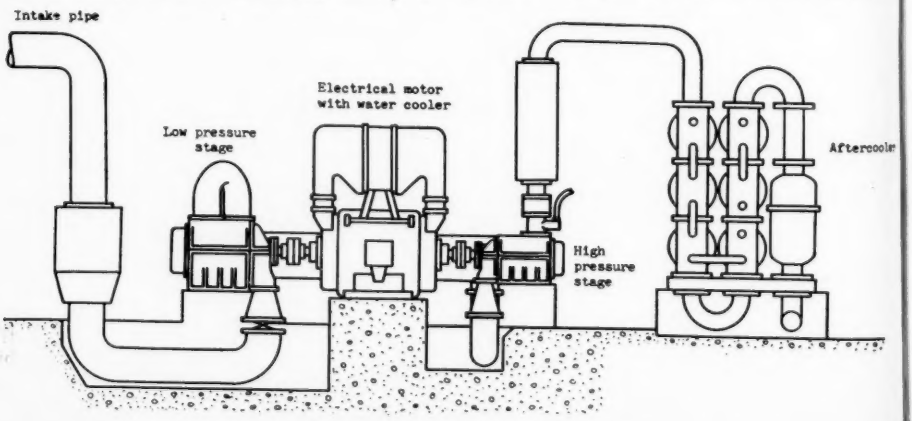


Compressor Rotors.



Underground Installation at Kiruna.

which control device has caused the shut-down. When starting the oil and cooling-water pumps are first started and then the main driving motor. When the compressor has reached full speed, which takes approximately eight seconds, loading is carried out manually. An interlocking device prevents the compressor from being started on load. When the screw compressors were first installed at Kiruna tests were carried out in connexion



Arrangement of the Kiruna Plant.

with silencing and it has proved possible to reduce noise to a level acceptable in industry.

Since the compressors have been in operation in this mine they have worked alternately on two and three shifts. From January, 1957, until May, 1958, the running time for one of the compressors was 5,300 hours, of which 4,700 hours was on load. For the other the figures are 4,600 hours running, of which 4,200 hours was at full load. The compressors operate at a delivery pressure of between 105 lb./sq. in., the intake pressure being normally 13·7 lb./sq. in abs., as the compressor plant is located 2,000 ft. above sea-level.

Screw compressors of this type installed at Kiruna by Atlas Copco A.B. have two rotors, the male having four lobes and the female six. The male rotor absorbs practically all the power required by the compressor, the female acting mainly as a slide valve and absorbing very little power. The rotors never touch each other or the casing, the clearance being fixed by the bearings and gears on the shaft journals. There is, therefore, no friction between the rotors and they require no lubrication. They are positive displacement machines, the working cycle being in principle the same as that of a piston-type compressor with controlled valves or slide valves. Fig. 3 shows a pair of rotors with the inlet and discharge ports drawn by dotted lines. In comparison with a piston-type compressor the screw machine requires considerably less floor space and smaller foundations as there are no unbalanced forces, while as there is no lubricant in the compression chamber it delivers oil-free air. The bearings and timing gears are the only parts subject to wear, so that overhauls are infrequent. Owing to its high speed (3,000 r.p.m. on a 50-cycle supply or 3,600 r.p.m. on a 60-cycle supply) the cost of the electric motor becomes lower and it has a high efficiency (95% or more), while the power factor of an induction type motor at this speed is very high (about 0·92). Cooling water consumption is also low and it is possible to recover the compression heat to a large extent for heating purposes.

Centenaries in Aluminium History

A chapter in the history of metallurgy is briefly related.

M. Schofield, M.A., B.Sc., F.R.I.C.

The history of metal production in Britain contains no more striking chapter than the birth of aluminium extraction just 100 years ago. Before the Hall-Héroult electrolytic process banished all other extraction methods Britain rivalled France in maintaining a vigorous development of Deville's classic process, based on the displacement of aluminium from its chloride by sodium metal. While 1858 is noted, since Deville, with the full financial backing of the Emperor Napoleon III, opened his first successful factory at Salindres, with its nearby bauxite and coal resources, then that year should also be commemorated as one in which Frederick Gerhard began the first British aluminium industry at Battersea. Deville in producing his "silver from clay" used a double chloride of aluminium and sodium as raw material, while British workers first used cryolite, then the double chloride, with the Bell Brothers operating in Durham and yet a further cryolite process at Wallsend-on-Tyne. All these preceded the successful aluminium industry established at Oldbury, Birmingham, by James Fern Webster and Hamilton Young Castner, a brief period in which Oldbury had "the largest aluminium works in the world."

This great phase in British aluminium based on sodium reduction depended for success on that young American Castner, who firmly established a British lead in sodium manufacture, thus enabling the Aluminium Company of Oldbury to outbid the Deville interests in France. To mention Castner serves to remind us that the centenary of his birth falls on September 11 of

this year, an anniversary even more significant than the centenaries of the years in which Gerhard and Deville independently established their works. Castner went from the Brooklyn Polytechnic to the Columbia School of Mines and might well have become a mining engineer or geologist, but when he set up as consultant he had succumbed to the craze for making aluminium, then still a " new " metal. Castner was spurred on to this problem of aluminium extraction by a professor of chemistry named Chandler, just as Charles Martin Hall was inspired by Professor Jewett, of Oberlin College. Jewett had published an account of Wöhler's classic preparation of aluminium by reduction of the chloride with potassium metal; Chandler had himself been a pupil of Wöhler.

Before turning to Gerhard's venture of 1858 and Castner's dominant role in aluminium extraction at Oldbury a little more of Castner's history is relevant. He was a brilliant chemist despite ill-health, which culminated in an early death at forty-one from tuberculosis. Once in private practice Castner foresaw the future use of aluminium if only it could be produced at an economic figure—that is, by some reduction process cheaper than Deville's use of sodium in place of Wöhler's potassium. Hence Castner's intensive efforts to produce cheap sodium, efforts which during his thirteen years in England established our sodium industry and produced sodium cyanide on a vast scale, just when McArthur's gold extraction process demanded this. In fact he made sodium at a shilling a pound to ensure in turn a more economic aluminium than the French interests could imagine.

Gerhard at Battersea used a technique worked on the laboratory scale by Allan Dick and Richard Smith at the Royal School of Mines in Jermyn Street. It was there that Dr. J. Percy had studied the possibilities of cryolite as a raw material, a sample of aluminium having been shown as a laboratory curiosity by Faraday at the Royal Institution. With glass apparatus first tried (thus avoiding Deville's copper impurity when he used copper boats), alternate layers of cryolite and sodium cut into small pieces were used, the whole being covered with cryolite and sodium chloride. After producing small globules of aluminium rather than buttons—not formed due to the density of the fused mass—the experimenters went on to use a platinum crucible lined with magnesia, since iron crucibles proved useless, as did porcelain and clay, which were also attacked by the cryolite. Cryolite at that time was entirely a natural product of Greenland and was tried out by Rose of Berlin and by the Tissier Brothers at their factory at Amfreville, near Rouen. Gerhard in adapting the Dick and Smith method at Battersea managed to succeed with earthenware crucibles lined with a solid cryolite-salt layer to give temporary resistance while his mixture of 270 parts cryolite to 72 parts sodium together with 150 parts salt reacted. Although aluminium imported from France at that time fetched 7s. 6d. per ounce Gerhard's difficulty was the price of sodium, then 16s. a pound even when manufactured by himself at Battersea.

Although Gerhard only lasted two years in this critical period, when aluminium was still almost a precious metal, the cryolite process was to be revived later in a most vigorous reaction process at Wallsend-on-Tyne in 1888, a year in which Webster at Oldbury was in full operation with a modified Deville technique. Gerhard seems to have ceased production in 1860 because of the competition of the Bell Brothers at Washington in Durham, a company working the Deville double-chloride process. Only the Bell Brothers kept aluminium production alive in Britain up to 1872, with aluminium still commanding 40s. a pound and with aluminium alloys proving more successful.

Before summarizing the Castner-Webster fruitful partnership, which produced more than 150 tons of aluminium on the eve of the Hall-Héroult bombshell, it is relevant to note this final use of cryolite and sodium metal by the Alliance Aluminium Company at Wallsend, a spectacular operation described in the *Chemical News* in 1889. A large crucible of fused cryolite and common salt was used, with lumps of sodium metal up to 5 lb. in weight added by workmen wearing protective clothing. Using a dipper this " dipping the sodium " or submerging the 5-lb. lumps was followed by the expected violent reaction in which " flame and dense white fumes " were evolved. Such white fumes of sodium fluoride were but part of this hazardous Wallsend extraction process, which was by then known as the Netto process, although it was a modification of Percy's idea.

As a fitting curtain to these three decades of British aluminium-making by sodium displacement the Webster-Castner operations in the Midlands eclipsed Deville production carried

on by Pechiney at Salindres. Original documents preserved in the board room at the Chance and Hunt works at Oldbury by Mr. W. Hacket, works manager, permit the tracing of Castner's vital part in this enterprise. It was a period in which Pechiney himself in writing to " Monsieur Chance " in 1888 considered aluminium unalloyed " a detestable metal," one with only lightness to recommend it and with " too many illusions regarding it." Webster, with no royal backing such as the French interests had enjoyed, developed his Aluminium Crown Metal Company up to 1887, in which year the Aluminium Company took over his company. Although believed to have come from farming stock Webster was technically-minded enough to see the need for using pure alumina ; hence his patents for cheaper aluminium in 1881–2 really depended on using pure alumina precipitated and dissolved in hydrochloric acid, the latter readily available by pipeline from the neighbouring Chance works. But paramount in all his operations was the cheap sodium which was eventually brought down to 1s. a lb. by Castner. This young graduate of the Columbia School of Mines, having seen little chance of developing his sodium-making in America, had begun operations in the Lambeth area near Waterloo Bridge, where the chemist W. H. Cullen helped him in turning out 120 lb. of sodium per day. Castner was invited to Oldbury, a site chosen in preference to Webster's Solihull venture, and here he produced his sodium in 18-in. diameter egg-shaped crucibles with huge top covers fitted with distillation heads. Up to twenty crucibles were worked continuously day and night, the sodium coming from the so-called " iron carbide " reduction of molten caustic soda. This modification of Deville's method was an essential to success, for not only did Castner use caustic soda in place of soda ash and operate at a lower temperature but his " iron carbide," from coking a mixture of tar and iron filings, had sufficient density to remain in contact with the fused alkali in contrast to the use of carbon alone.

With a capital of £128,000 the Aluminium Company took chief place among producers in those few years prior to the industrial adoption of Hall's electrolytic process. The company used twelve regenerative furnaces for converting Webster's purified alumina to the double chloride with sodium and a machine " similar to a tobacco-cutting machine " for slicing the sodium. Cars on a tramway transported raw materials to hoppers above the furnace hearths. From 600 lb. cryolite, as flux, 1,200 lb. of sodium-aluminium chloride, and 350 lb. sodium slices as charge for each unit, aluminium of 99·2% purity was produced as the highest grade of that period. Since one ton of aluminium involved the consumption of 6,300 lb. sodium metal in its production it need hardly be emphasized that Hamilton Castner's intensive efforts in sodium-making was the key to success.

Castner in his thirteen years in Britain went on to produce sodium by electrolytic means, to prepare caustic soda by the process which still bears his name, to produce sodium cyanide from molten sodium, charcoal, and ammonia, to make sodium peroxide, and to find other outlets for his sodium when the Aluminium Company ceased operations. At his centenary let us remember that he was born in the same year in which Gerhard had begun the British phase in aluminium history with his Battersea venture.

Sarawak's Mineral Industry

Sarawak's exports of oil and gold last year were valued at a record total of $ (Malayan) 377,000,000 (against $357,000,000 the previous year). Most of this, however, consisted of oil from the neighbouring country of Brunei, piped to Sarawak, where some of it was treated at the Lutong refinery. Exports comprised crude oil, petrol, kerosene, gas oil, fuel oil, diesel fuel, and diesel fuel bunkers. About $11,000,000 was paid as revenue in royalties, company tax, and mining rents.

The main mineral resources in Sarawak, are oil, gold, bauxite, coal, stone, phosphate, antimony, and mercury. Last year glass-sand of first-class quality was found and small occurrences are known of silver, lead, copper, diamonds, gypsum, ilmenite, zircon, monazite, iron ore, sapphire, and kaolin, while salt is obtained by native methods in the interior. Mineral products during 1957 consisted of oil, gold, phosphate, bricks, lime, tiles, gravel, and stone, of an estimated value of $5,348,000, says the Sarawak annual report.

Mining leases covered 1,424 acres, of which 944 acres were for gold and 480 acres for bauxite; this is the only land reserved exclusively for mining. Oil rights are held by Sarawak Oilfields, Ltd., over 10,850 sq. miles of land and the off-shore continental shelf area. About 36,650 sq. miles, representing some 77% of the land area held by the oil company, were surrendered, mostly in hinterland country built of rocks in which oil so far had not been found. Fourteen general prospecting licences and two mining leases were issued. Most prospecting licences were for gold in the Bau district; four were for antimony, one for mercury, and one for coal at Silantek, examined early in the year by Japanese technicians. A mining lease for bauxite was issued to Sematan Bauxite, Ltd.

Oil.—The 1957 output of oil from Miri, was 65,906 long tons, valued at $3,600,524; the yield is decreasing. The oil was obtained from 180 pumping wells, ranging in depth from 300 ft. to 3,050 ft.; it came from middle and upper Miocene sands. Oil exported from Lutong was 5,476,759 long tons, valued at $376,852,149. Most was crude oil, but there was also enriched crude petrol, diesel fuel, kerosene, gas oil, isobutane concentrate, naphtha, and Lutong residue. The refinery output in long tons was: Petrol 398,486, gas oil 54,659, kerosene 33,000, diesel fuel 1,116,921, Lutong residue 567,976, naphtha 159,775, and isobutane concentrate 13,893.

During 1957 the search for new oilfields continued energetically, the main effort being in the off-shore area of the continental shelf. A steel platform was built at Siwa, some eight miles out at sea, and two test holes drilled, the deepest reaching 7,680 ft. The rocks with which the oil is associated on the Miri field were met, but no oil was found. A mobile drilling barge now being built will be used to test further promising parts of the 55,000 sq. miles of Sarawak's continental shelf.

Other Minerals.—Gold production for 1957 was 902 oz., an increase of 284 oz. over 1956. Phosphate production was 465 long tons last year, while other production totals were: Stone 110,849 cu. yd., gravel 16,789 cu. yd., bricks, 3,240,000 pieces, lime, 253 tons, and tiles, 120,000 pieces.

General.—Some 15 miles of the 90-mile road from Serian to Simanggang was started in 1957 and quarrying of stone from some of the fourteen possible quarry sites discovered near the road-trace was providing ample material for road building and saving large sums which would otherwise have to be spent in transporting stone. Mining equipment for working the bauxite at Sematan in west Sarawak was imported and a washing plant and a wharf built. Arrangements for mining were nearly completed by the end of 1957 and export was to start in early 1958, with shipments of about 180,000 tons annually. Steel lighters of 250-ton capacity would take the bauxite about four miles to sea to 10,000-ton freighters which would carry it to Japan and Formosa.

Bauxite was first discovered in west Sarawak during 1949 and over twenty occurrences are now known, of which three appear to be large and accessible enough to be worth mining. They would yield about 5,625,000 tons of washed bauxite. The amount of ore available in the remaining occurrences is unknown. Most of them are isolated, inland, small, or contained ore of poor grade, but only a reconnaissance of the areas in which they occur has so far been made and a more detailed examination will probably reveal extensions to the known bauxite deposits and lead to the discovery of more ore.

The British Aluminium Co., Ltd., prospected from late 1949 to 1952; it was looking for about 20,000,000 tons or more of bauxite which was not found. In 1955 a local company named Sematan Bauxite, Ltd., was formed; after further investigation plans were made in 1956 for mining the 2,600,000-ton deposit at Munggu Belian near Sematan.

The following minerals described briefly have been investigated, but were not mined during 1957.

Coal.—One general prospecting licence for coal was issued over the Silantek-Abok area in west Sarawak last year and a party of Japanese engineers and company directors visited the field.

Antimony.—During 1957 there was no recorded mining of this mineral, but four general prospecting licences were issued for the testing of deposits in the Bau district, the Baram Valley, and the Selalang and Roban areas of the lower Rejang valley. An examination of the Baram river occurrences was made in 1957. In the past, there has been a considerable production in Sarawak of coal, antimony ore, and mercury ore.

Large Stripping Shovel

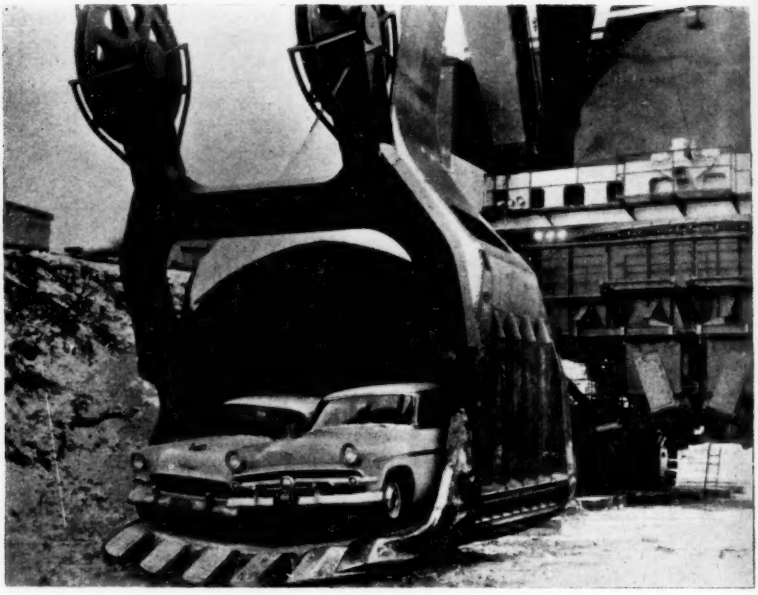
A huge machine capable of a 60 cu. yd. "bite" is described

W. Schweisheimer

What is claimed to be the world's largest power shovel is stripping overburden in the Georgetown mine of the Hanna Coal Co., near Cadiz, Ohio. This giant machine is probably the largest mobile land machine ever built in the United States and has been named "The Mountaineer." It was built at a cost of $2,600,000 by the Marion Power Shovel Co., of Marion, Ohio, and it stands as high as a 16-storey building. From the ground to the top of the platform attached to the boom the shovel rises more than 160 ft. into the air. It can scoop up 60 cu. yd. of dirt and rock at a single bite and handle something like 2,000,000 cu. yd. in a month.

The Mountaineer will make a round cycle of digging overburden, completing a 180° swing, depositing overburden, and returning for another load of dirt or rock once every 45 seconds. Only one man is required for actual operation, controlling all the digging functions of the machine through two foot pedals, two hand levers, and one whistle cord. In addition an oiler checks the lubrication system and performs minor repair work. Each of some 500 bearings of the giant machine is greased automatically. When it is necessary to move the machine forward a man on the ground operates the steering and crawler mechanism. Each of the eight crawlers upon which the shovel stands and moves measures 8 ft. high, is 23 ft. long, and 54 in. wide, and each crawler weights 60 tons. Each of the four pairs of crawlers is powered by a 250-h.p. motor. A bulldozer is co-operating with the machine. It works on the coal seam with the shovel at all times to push fallen earth and rock to

Work in a Strip Coal Mine.



Huge Bucket of the Mountaineer.

where it can easily be reached by the dipper.

The machine operates 22½ hours a day, seven days a week, in three shifts. Time lost for maintenance averages only 5% to 6%.

An interesting feature of the Mountaineer is the automatic lift within the shovel's 5-ft. centre pin. Its job is to hoist the operator aboard. Three men can ride in it and it significantly increases the safety of the operation by reducing the hazards of clambering on and off the machine while the shovel is in operation.

The Mountaineer's cab is similar to a three-storey house, 37 ft. high. For flexibility, the shovel has two operator's booths, one on each side of the house. The cab is equipped with electric heating and air conditioning, with a sliding picture window, vinyl tile floor, and it is finished with imitation wood panelling. The shovel, furthermore, is equipped with telephone and short-wave radio equipment.

The dipper or bucket of the Mountaineer is so big that it is rather hard for the operator to see what he is doing while he is performing his job. To improve this condition a television camera will be mounted at the end of the boom and a receiver put in the cab. Consequently the operator will be able to see on the television screen what is going on outside the machine. The handle to which the dipper is attached is 92 ft. long.

This big machine is powered by 16 electric motors, the total rating of the main a.c. motors being 4,650 h.p. To swing the machine's boom four motors supply the force, each of 187·5 h.p. The total horsepower rating of all the motors connected with the machine totals 12,000, about equivalent to that needed by the largest ocean-going freighters. Total power demand of the machine at peak performance will be 6,840 kW. The lifting power of the Mountaineer is immense. It has been estimated at some 500,000 lb. or 250 tons.

The task of such giant rock-moving machines in strip mining is to remove 80 ft. to 120 ft. of overburden after it has been loosened by blasting. When the big shovel has gone by bulldozers are used to scrape the seam clean. After that smaller shovels take over to remove the coal, etc. The materials removed go from there to cleaning plants in special 55-ton trucks which use part of the uncovered seam for a road.

The Mountaineer is equipped with four automatic hydraulic levelling jacks. These are electrically controlled and there is one at each corner of the lever frame. These

jacks are most important for undisturbed working of the machine. Their purpose is to keep the revolving upper portion of the machine absolutely level while operating, even though the Mountaineer might be standing on uneven terrain.

Strip or open-pit mining now accounts for 23% of all the bituminous coal mined in the United States and all the progressive mining companies to-day conduct reclamation projects simultaneously with their open-pit work. A big advantage results from such proceedings for both companies and neighbour communities. The reclaimed land is said to be excellent for dairy farming. Even lakes have been added to the reclaimed landscape. Open-cut mining operations contribute greatly to the enrichment of the soil in Ohio, because in the process of mining, a vein of water-soluble limestone is broken up and mixed with the soil. It is interesting to note that when cattle are given the choice of a grazing spot they invariably choose restored fields over undisturbed ones. Land reclamation adds about 3 cents per ton on the production cost of coal mined by the Mountaineer and similar big automatic shovels.

Ore-Dressing Notes

(7) *Production.*

New Uranium Mill

Interesting particulars of the operation of the Dawn Mining Company's 440-ton mill, which began work in August, 1957, were given in a paper[1] by D. Hargrove presented at the North-West Mining Association Meeting of December 7 last. Most of the ore treated comes from the Midnite mine, 22 miles north-west of the mill. The main uranium mineral is autunite which occurs in a schistose and cross-fractured formation, the ore being amenable to straight acid leach and ion exchange. There is some urano-thorite. By the end of 1955 ore reserves were sufficient to justify mill construction and a 500-ton sample was treated in a pilot plant by an R.I.P. circuit. The mill went on stream on August 13, 1957, and the first yellow cake was produced four days later, about 20 months after the beginning of the test work.

The Dawn mill building is of wooden construction, this being acid resistant and locally available, launders being of wood fastened by stainless-steel nails and bolts. Devereaux type agitators with rubber-covered shafts and impellers are used and rake shoes are of stainless steel. Thickener mechanisms and cones are rubber-covered, the pulp piping is rubber-lined, and hoses are used wherever possible. "Saran" piping is used for solution.

As the mine only operates for nine months of the year stockpiling of ore and reagents has been necessary and to help with this a nearly level mill site was chosen although this entailed more pumping than is usual.

[1] See *Engg. Min. J.*, Mar., 1958.

The Vacseal pumps which handle the pulp have the intake level controlled by means of bubble pipes inserted near the pump suction in the sump. These control the pulp level within 1 in. by means of variable-speed drives. Grinding to *minus* 3% *plus* 28 mesh and *plus* 47% *minus* 200 mesh is accomplished in a ball-mill closed by first a drag classifier and then a hydroclone. The final overflow from the latter is at 50% solids. Fine grinding is not needed for metallurgical reasons so much as for convenience of material handling. In the leaching 130 lb. of sulphuric acid is used per ton and extraction is over 96%. This is an improvement on the indications in the original pilot work. The cyclone overflow is diluted to 18% to 20% of solids and heated to about 50° C before two stages of agitation, which takes some two hours; approximately 75% extraction is obtained at this point, a figure which will be improved on when difficulties in the heating system have been overcome.

The discharge at this stage of agitation is thickened and the pregnant solution is sent to clarification storage and stripping. The underflow goes through five further stages of agitation at 50% solids, heat and further sulphuric acid being used. The discharge is then thickened and the pregnant solution sent up to the first stage of agitation. After further thickening and repulping the spent tailings are discharged to a dam. The pregnant solution was clarified before ion exchange, but difficulties arose which were finally solved by increasing the size of the resin. Unclarified solution is now fed direct.

Ion exchange is performed in four 8 ft. by 15 ft. columns. Each of these is equipped with a bottom distribution system of piping covered by sized gravel and sand. The base

anion resin rests on this sand and occupies 270 cu. ft. It is loaded with uranium as uranyl-sulphate. During the loading cycle three columns are on stream. The first receives the solution at the highest bottom pressure ; there is a drop of 15 lb. per column when things are operating normally and flow rates are believed to be of the order of 5 to 6 gallons per minute per square foot of cross-section area. A column is considered loaded and ready for elution when its uranium content is equal at both entry and discharge. At the same time the second column in line should be showing a break-through of up to 10% of the value of the IX feed. The third column strips practically all the remaining uranium and gives a nearly barren effluent. After loading the column is rinsed with water which displaces most of the solution ; this carries on through the succeeding columns. After rinsing the column is back-washed with 200–250 gal. per min. of water through the bottom distribution pipes. The resin bed is raised, loosened, and resorted. Slime particles are now carried up and out with this back-washed water. As some resin is flushed out at the same time the back-wash stream is passed over 100-mesh screening to trap any such material.

Elution is next performed with ammonium nitrate made up from nitric acid neutralized by anhydrous ammonia. Excess nitric acid is added to keep acidity correct. When concentration in the eluting solution has built up sufficiently the eluate is sent to precipitation storage. The last stages are an acid rinse and a water rinse. The sulphuric acid thus used helps to regenerate the resin after each elution. Amberlite 400 anion resin is used with a nitrate capacity of 4·2 lb. per cu. ft. A concentration ratio in the IX step of 20 : 1 is normally obtained with an IX feed assaying 0·5 g. per litre to 0·6 g. per litre. The concentrated eluate is pumped to three pachucas in series. Lime slurry is added to the first two and gaseous ammonia to the third. The lime slurry precipitates as gypsum and also takes down most of the iron as ferric hydrate. Overflow from the third pachuca goes to thickening but the underflow is filtered on stainless steel. The cake is repulped and returned to the first agitator in the main leach circuit. It usually assays between 1% and 2% uranium. The filtrate forms the feed for a second bank of three pachucas. Ammonia is added in the first and last of these to give a final pH of between 6·8 and 7·0, at which the uranium is completely precipitated. Overflow from the last pachuca is thickened, heated to 90° C, rethickened, and then filtered. The filter cake averages 50% solids. It is dried, loaded into drums, and shipped.

The labour force at this mill totals 80 men, including seven on administration, ten mining, three in the scale house, four in the laboratory, and 55 in the mill, which works on four complete shifts of six men per shift each under its shift boss. Each shift works a 42-hour week. There is a maintenance crew of six mechanics, two electricians, and two carpenters on a 48-hour week under the master mechanic. In addition to a reagent consumption of 115 lb. per ton of sulphuric acid and 3·3 lb. per ton of nitric, 6½ lb. of calcium oxide are used, 0·28 lb. per ton of Separan, 2·8 lb. per ton of anhydrous ammonia. The power requirement of the whole plant is 35kW hours per ton. There is a fair amount of instrumentation in the plant and most controls are air operated.

(8) *Concentration.*

Spirals

A useful review of the present position of the Humphrey's spiral concentrator is given by J. V. Thompson in a recent article.[1] The spiral was first introduced in 1943 to recover chromite from beach sand and by the end of 1957 nearly 10,000 of these appliances had been made. Amenability testing fully representative of large-scale work is claimed to be possible with a sample of between 10 lb. and 40 lb. in weight operating on a full-sized spiral in closed circuit. Larger samples are of course preferable, particularly when the preliminary work has encouraged pilot-plant test design for full-scale operation. The spiral is subject to the limitations of all wet gravity concentrators, but has certain advantages, including the fact that the only power required is for delivery of feed and recirculation of partly-processed products. Wear has been considerably reduced by improved alloys or, in special cases, rubber lining. Where no shape factor can be exploited the operating sizes lie somewhere between 14 mesh and 200 mesh. There should be a specific gravity differential in such cases of more than 1·0 between the minerals treated. Closer densities are successfully handled, but the problem is more difficult. Mica and any metal having a characteristic flaky shape is not subject to

[1] *Min. Engg.*, Jan., 1958.

simple gravity considerations. If blocky it reacts in accordance with its density, but if thinly plated it is swept into the fast water section (the outer portion of the spiral channel), while blocky or normal angular material remains on the inner channel at the lower velocity. When phosphates are treated in the spiral the oiled phosphate drop is swept to the fast-running portion of the spiral while the wetted quartz remains on the inside. This is a special application of froth flotation.

An ingenious variation from standard rougher cleaner treatment in connexion with the treatment of an iron ore is cited. Feed in a plant now under construction will be to about 384 spirals and will come from open-circuit rod-mill grinding. The top mill discharge size should be *minus* 8 mesh or 10 mesh. With heavy minerals lying between 8 mesh and 20 mesh in the feed a good rougher recovery on the coarse sizes is made by using a high-pulp density so that the pulp is viscous enough to hold the coarse heavy mineral in the slow-running section of the spiral. If this rough concentrate was now sent to the cleaner spirals it would be so diluted and slime free that there would be difficulty and probably an undesirably large return of this mineral to the rougher section. This trouble has been neatly avoided by the use of simple classification in a single pocket classifier, by means of which a coarse underflow of high-grade heavy mineral is produced, while the overflow which has now been stripped of such particles is sent on to the cleaner spiral for finishing treatment.

The article includes a flow-sheet of the Climax Molybdenum operation, in which 752 spirals are used to recover tungsten from the flotation tail of the molybdenum plant. Most of the tungsten is recovered at between 200 mesh and 325 mesh though some of it finer still.

About three-quarters of all the spirals now in use are working on two major operations. The parent company which developed the spiral uses nearly 36% on placer beach sands, while iron beneficiation accounts for nearly 36%.

(9) *Production.*

Cobalt Consolidated

The Cobalt Consolidated mill treats ore from a group of mines near Cobalt, Ontario. The minerals include native silver and the arsenides and sulpharsenides of cobalt, nickel, and iron. Host rocks include conglomerate, diabase, and lavas and the silver is associated with a calcite gangue. Milling began in 1950 with stamp crushing but at 150 tons daily. In 1955 ball-mills took over, the tonnage being raised to 350. The fine-ore bins feed (Fig. 1) two parallel grinding circuits and make first a table and jig concentrate; next, after grinding to 60% *minus* 200 mesh, a flotation concentrate. Recoveries are 86% of the cobalt and 91% of the silver.[1]

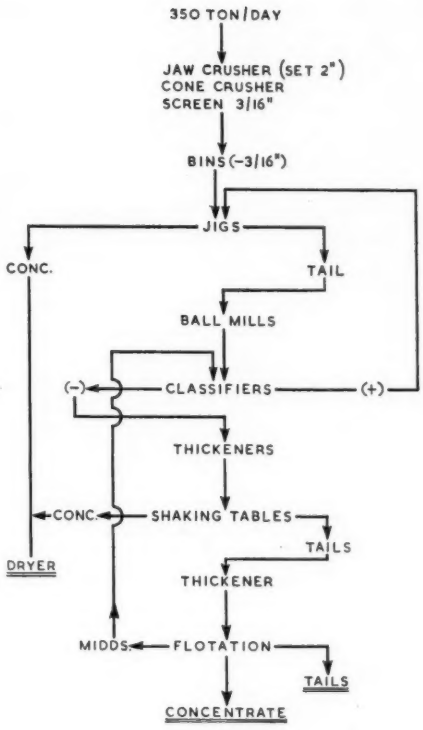


Fig. 1.

Book Reviews

Die Blei-Zink-Erzgänge des Schwarzwaldes: Monographs on the German Lead-Zinc Occurrences No. 14. By R. METZ, M. RICHTER, and H. SCHÜRENBERG. Paper covers, 275 pages, illustrated, with 15 plates and maps. Price 40 DM. Clausthal-

[1] "The Milling of Canadian Ores," 6th Commonwealth Congress (p. 167).

Zellerfeld : Ges. Deutscher Metallhütten und Bergleute e.V.

The lead-zinc occurrences of the Black Forest have been mined since ancient times and uninterruptedly since the 11th Century. The silver industry was founded in the region in the Middle Ages, although the years of prosperity experienced in the 13th and 14th centuries came to an end with the 30-year War, and when mining was restarted some 200 years later lead became the principal product rather than the silver, while at present fluorite has become an important source of income. The work under review, like other volumes in this series of monographs, deals with the geology of the area and reviews its tectonics, going on then to describe the mineralization, the research completed having established that eight types of hydrothermal veins exist in the area, each of them occurring, generally speaking, within clearly-defined boundaries. The complete mineral assemblage exposed in the famous Schindler and Teufelsgrund veins has enabled the authors to present a paragenetic sequence for all other lodes in the Southern Black Forest, although in the Middle forest the mineral assemblages are more varied. The book contains useful summaries in both French and English.

Underground Lighting in Mines, Shafts, and Tunnels. By A. ROBERTS. Cloth, large octavo, 292 pages, illustrated. Price 63s. London : The Technical Press, Ltd.

The author of this book, Director of the Postgraduate School of Mining in the University of Sheffield, is a well-known writer on the problems of underground lighting and in the present work he has drawn together a wealth of experience which covers lighting in its fullest sense—that is, as a branch of engineering. Modern lighting techniques have advanced enormously in efficiency and in the process a new terminology has arisen which this book explains and discusses. The basic problems of lighting are reviewed and modern solutions proposed in a way designed to appeal where work lies underground.

The book is planned in three sections, the first dealing with fundamentals. In it terms and units are defined and the science of photometry explained in relation to its use in design. In Section 2 various lighting problems are examined, while Section 3 is descriptive of various lighting appliances, their installation, and their care and maintenance.

Water in Mines and Mine Pumps. By JOHN SINCLAIR. Cloth, octavo, 130 pages, illustrated. Price 27s. 6d. London : Sir Isaac Pitman and Sons, Ltd.

Intended primarily for mining students this little book will interest all engineers interested in drainage problems underground. It deals first with the sources of underground water and the dangers arising therefrom, going on to cover pipes and pipe fitments. Thereafter the various types of mine pumps are considered in turn, a final chapter covering " Pumps for Special Purposes." The author points out the increasing importance of centrifugal pumps, particularly of the submersible types and also discusses the hydraulic transport of coal and ore.

Coal Mining Law. By JOHN SINCLAIR. Cloth, octavo, 429 pages. Price 50s. London: Sir Isaac Pitman and Sons, Ltd.

Dr. John Sinclair, Professor of Mining in the University College, Cardiff, is also a barrister-at-law and as such well qualified to review those aspects of the law affecting the coal-mining industry. The present work, intended primarily to cover the syllabus of the legislation papers of the examinations for Associate Membership of the Institution of Mining Engineers and for the First Class Certificate of Competency for Colliery Managers, is nevertheless interestingly wide in its scope, particularly in its broad outline of the legal system operating in England and Wales. A second section covers the Mines and Quarries Act, 1954, and a final part deals with industrial injuries and diseases, colliery leases and the law of support, and, finally, with trade unions and wages. Managers in this country may well find this book of more interest than the student.

☛ Copies of the books, etc., mentioned under the heading " Book Reviews " can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

Engineering Log

Ideas about the probable exhaustion of the world's coal and oil by A.D. 2000 are being abruptly upset, the present indication being that the reserves of fossil fuels will last for thousands of years. New discoveries, better use, and the threat of nuclear competition, are forcing forward a soberly realistic outlook on coal economics, as it becomes increasingly clear that marketing rather than supply will soon be the main problem. Since Britain's manufacturing capacity must depend on export sales, and since power is an important element of manufacturing cost, British mined coal must be examined for its ability to compete with alternative fuels. Economists consider that great savings can be made by integrating the production of all fuels, power, electricity, and chemicals ; only thus, they say, can the best raw material be applied to the specific job. As an example, many chemicals which can only be produced in limited quantities from coal tar or by fermentation can be made in bulk and cheaply from petroleum ; in other cases combined operation by gas and oil may offer the most economical technique. Although there is no question of retreat from the nationalization of British coal mines the need for more realism in the policies of capitalization must be faced. The present programme is spending about £1,000,000,000 in order to increase coal production by some 20,000,000 to 30,000,000 tons per annum.

Would this money be better used in develop alternative sources, not necessarily in Britain. There is a precedent in the Government's heavy oil investments in the Middle East. Western Europe is increasing its use of imported fuel, both oil and coal, the prime consideration being cheap industrial energy ; in this connexion large unloading installations have been made at the docks. The Common Market countries are not only vigorously seeking new external sources of supply but are also building integrated plants to use coal and oil to produce gas, electricity, chemicals, and fuels, and no favour is shown to national coal resources. These points, made in a broadcast, have suggested a redefinition of Britain's coal-mining objectives. These could be maximum production at marginal quality, maximum employment in coalfields, or cheap fuel at low capital outlay. The conclusion is that, subject to strategic and political considerations, these issues need clarification. Meantime, Britain's energy policy, it is thought, completely hamstrings industrial activity and ties up vast resources which could be better employed elsewhere.

* * *

Experimental stress analysis, although a relatively new tool, has a vital contribution to make to the development of the turbo-jet engines of the future. Jet engines parts are of such complexity that the engineer cannot afford merely to calculate stresses. He must bring the experimental as well as the theoretical approach to the problem. For this reason experimental stress analysis plays an important part in the design of such components as turbine wheels and compresser and turbine blades, which operate at speeds of up to 26,000 r.p.m. at ever-increasing temperatures. Many methods and devices assist the engineer in his work. The most versatile and the most indispensable of these are three : The wire-resistance strain gauge, brittle lacquer, and photo-elasticity. The gauge is probably the most widely used since its modest size, light weight, accuracy, simplicity, and adaptability recommend its use for the solution of a wide variety of problems. It consists of a very fine filament of high-resistance wire cemented to the structure under test but electrically insulated from it. When the load is applied the surface strain induced is transmitted to the wire and stretches or compresses it. The change in the length of the wire is measured by the change in its electrical resistance and an accurate measurement of strain on the structure is thus obtained. Such gauges are used on turbo-jet turbine buckets, while others are much used in blade vibration studies. Brittle lacquer is another useful stress measurement tool. The surfaces of the structure to be tested are given thin coats of the lacquer. When the loading is applied, tension strain produces cracks in the coating as the sensitivity threshold is reached. The analyst is thus enabled to locate the area of greatest stress and also the direction of the principal stresses. Under specially-controlled atmospheric conditions the coating can be calibrated so as to show magnitude of stress. This is a particularly important aid, since the entire surface can be surveyed by this method instead of only a finite area. Brittle lacquer is used equally easily on rotating or stationary components. Recently a porcelain-enamel coating has been evolved to

overcome the limitations of brittle lacquer and this can be used at temperatures of up to 700° F., in the presence of oil, steam, or other adverse conditions. Photo-elasticity is used for model testing in three-dimensional stress studies. An exact scale model of the structure to be tested is made from suitable photo-elastic material. It is placed in a field of polarized light and load is applied. The stresses are visible in a series of brilliantly-coloured bands which can be interpreted to give a quantitive as well as a qualitative analysis of stress distibution. This is a method particularly well suited to the study of complex and highly-irregular shapes—for instance, dovetail sections of turbine blades. Besides these three major tools of the experimental stress-analyst X-ray analysis, inductance and capacitance gauges, and many other devices and techniques are available, both for the analysis itself and for the recording of the data. Their use saves both time and money in the development of better jet engines for defence and transport purposes.

* * *

The first of the three power stations of Burma's hydro-electric project on the " River of Ogres " is now being built at Loikaw, near the Lawpita waterfalls. On completion, in 1960, the work will have cost nearly £20,000,000 and will supply two-thirds of Burma's power with its annual output of nearly 1,700,000,000 kW hours. The Balu-Chaung River is a tributary of the Salween and drops nearly 2,000 ft. in 10 miles in a series of waterfalls. The work was sanctioned in 1954, but a start was delayed till 1957. Pylons will carry electricity 250 miles south to Rangoon and 270 miles north to Mandalay, serving 34,000 sq. miles and 12,000,000 people This project, together with new roads now under construction, should do much to open up the State of Kayah.

* * *

The vineyards of the small but precious district of Champagne were famed as far back as the Roman Empire. Champagne as now known, however, originates from the genius of a 17th Century Benedictine monk, Dom Perignon, who worked out the principles on which its production to-day is based. A great deal of toil, thought, and happy chance goes to the making of the wine. First and most fortunate soil and climate in the undulating chalk hills of Champagne favour the growth of the special grape. Cultivation, harvesting, and processing require constant application, skill, and art. Pruning in early spring is followed by flowering in May and, after months of careful tending, by the great autumnal vendange. As the grapes are gathered into baskets they are subjected to minute scrutiny and sub-standard fruit is rejected. The perfect grapes are carried to the wine presses, where four tons of grapes are spread on the flat press, to yield probably about 572 gal. of juice, which is stored in 44-gal. casks. Many of the firms have tunnelled long galleries in the chalk hills to serve as cellars, the famous firm of Mercier, at Epernay, for instance, having 12 miles of such cellars, serviced by electric trains. In these cellars the casks lie during the first months of fermentation. Around Christmas clear wine is drawn off and tasters begin the all-important task of blending and marrying the wine in vats. Any harvest of particularly fine quality will be preserved to itself as a vintage year. After blending comes bottling and the second period of fermentation in bottle, which gives the wine its characteristic sparkle. The bottles are stored neck downwards in racks and placed at an angle of 45°. The Mercier cellars contain 12,000,000 bottles, and a constant temperature of 10° C. is maintained. A sediment forms and to ensure that it settles on the cork and can be easily removed the bottles are turned daily and slightly shaken. After 6 months they are removed from the racks and stored vertically, still neck down, for a further period of several years. Finally the bottles are taken, in the same position, and iced at the neck. The cork is released and explodes from the bottle under pressure of the natural effervescence of the wine and brings away with it the frozen wad of sediment. The bottle is then topped up with an old wine liqueur, varying in sweetness according to the palate of the market to which it is to be supplied. After rewiring, sealing and labelling, the wine is at last ready to be dispatched and worthy of any demands that may be made of it.

* * *

The French Government has decided to develop the 4,000,000,000-kW power scheme on the Kouikou River in the Congo at a cost of over £50,000,000. Topographical and hydrological studies have been completed by the group set up in 1954, test borings made, and an access road constructed through the gorges. Two 380,000-V. lines are to carry electricity from the generating station to

Pointe Noire where the large bauxite deposits from French Guinea are to be treated. Other plants will produce ferro-manganese, ferro-chrome, and ferro-silicon from deposits in the Congo or the Gaboons. The decision to proceed at this time with this giant undertaking would appear risky. It may meet opposition from the Belgian proposal for developing the Inga River, an even larger scheme. There is also the Congo's Assembly resolution (dated January 1, 1958) asking for all plans and files of the Kouikou project to be handed over to local authorities, perhaps unimportant to-day but potentially a rod in pickle.

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In 1954 the United States National Bureau of Standards undertook a programme of research on thermal insulation, in order to find better methods of insulation and to determine data for calculating the thermal conductivity of air spaces of uniform thickness under different conditions. The measurements obtained indicated that the insulating properties of air space can be increased by reflective surfaces and it seemed reasonable to assume that fibrous insulating materials would gain in efficiency if given such reflecting surfaces. It was not known, however, how much the insulating properties of an air space in conjunction with a reflectively surfaced fibrous insulating material might depart from that of an exemplary type of air space in the course of the application. A number of different reflective and fibrous materials were therefore tested in different combinations and the results compared with the previously established data. To obtain heat transfer measurements a rotatable guarded hot-box with test panels was used. This apparatus consists of two chambers coupled together so as to form separate, well-insulated chambers, with the test panel placed between them. One chamber is refrigerated, the other being heated electrically, and the temperatures are maintained at 0° F. and 70° F., respectively. A metering box is placed against the centre of the warm side of the panel and is kept at the same temperature as the warm chamber. There is thus little exchange of heat between the metering box and the surrounding air. The electrical power input to the metering box is measured accurately and indicates the rate of heat flow through a known area of the test panel. The insulating value of air spaces is known to be affected by orientation and for this reason the apparatus is adjustable and can be rotated on a horizontal axis so that the panel can be tested in positions equivalent to those required for its use on floor, walls, or ceiling. The hot-box takes a panel 5½ ft. by 8 ft. During the series of tests made 28 panels were used, 23 of them insulated with reflective surface membranes used alone or in conjunction with fibrous insulations. The remaining five panels provided a basis for comparison of insulations without reflective surfacing. Each panel was tested in five positions, moving by angles of 45° from horizontal with heat flow downward to horizontal with heat flow upward. Part of the experiment was devoted to investigating tandem air spaces and examined the effects of moisture condensation on reflective surfaces, air circulation between the spaces through holes in the membrane, perforations in the membrane which were introduced to render it permeable to vapour, and non-uniform, or wedge-shaped, thicknesses of air space. The balance of the investigation was taken up with measurements on panels of commercial fibrous insulating materials with various types of reflective surface. Calculated and observed insulating values for the panels tested were in agreement within 10% in almost all circumstances where the air spaces conformed to the exemplary spaces used to find the original data. Wider departures occurred when such factors as moisture condensation, lack of uniformity in air space thickness, and air circulation between tandem air spaces were introduced. Moisture condensation on reflective surfaces decreased the insulating effect of an air space by 30% for a horizontal air space with heat flow downward, or by 10% for other orientations. Condensation can be avoided by making the reflective membrane porous to vapour. The insulating effect of wedge-shaped spaces was substantially less than that of air spaces of a uniform thickness. The circulation of air between tandem air spaces caused reductions of 18% and 12% insulating value in vertical and 45° angled air spaces respectively. In a horizontal position no significant reduction in insulating effect was remarked. The tests of tandem air spaces indicated that the position of the reflective surface, where only one is used, may affect the thermal resistance of an air space because of the effect of radiation from the sides of the framing.[1]

[1] *Refrigg Engg*, (including *Air Conditioning*.) April, 1958.

News Letters

VANCOUVER

August 5.

Mineral Property Taxation.—The Mineral Property Taxation Act of British Columbia was declared last month to be *ultra vires* by Mr. Justice Sullivan of the Province's Supreme Court. The validity of the statute had been challenged by Texada Mines, Ltd., and the Utah Co. of the Americas, both of which had exported iron ore and concentrate from Vancouver and Texada Islands to Japan. A week prior to the ruling both companies had been successful in their appeals against assessments under the Act in a suit heard by Mr. Justice Maclean. Although the professed purpose of the Act was to provide revenue Mr. Justice Sullivan found the true purpose to be the imposition of an embargo on the export of iron ore, a procedure not within the competence of the legislature.

The decision has been acclaimed by the mining industry and, despite the likelihood of an appeal, is said to have restored confidence among the companies engaged in iron mining and exploration. The Utah Co. has worked out the Iron Hill deposit, near Campbell River, but is contemplating production from other relatively small properties on Vancouver Island. Texada Mines has shipped continuously on a major contract to Japan for the past 1½ years since shipping facilities were repaired; they had been destroyed by a freak movement of ocean water. The Empire Development Co., Ltd., resumed production early this summer on a substantial contract, but has since been compelled to suspend operation due to forest closure. The suspension is entirely temporary and work will be resumed as soon as the fire threat is relieved.

Fort Nelson.—Magnum Copper, Ltd., has been incorporated to acquire and explore a group of 64 claims in the Racing River area of north-eastern British Columbia, 25 miles south of Mile 408 on the Alaska Highway and 125 miles west of Fort Nelson. Surface sampling has revealed high-grade copper deposition and Dr. Chris Riley, the consulting geologist, has suggested the possibility of reserves of 1,500 tons of ore per vertical foot with grade of 5% copper. The company is amply financed and an ambitious development programme is already in progress.

Alberni.—Tofino Mines, Ltd., has been compelled to suspend development work at the Tofino gold mine during the long dry summer due to forest regulations. Since reclaiming the 1,500-ft. level adit 118 ft. of driving was done on two narrow parallel veins separated by 3 ft. of waste rock. All material mined to date has been sub-marginal, but this is not discouraging to the management, inasmuch as the projected position of the ore-shoot is yet 500 ft. in advance of the face. The work will be resumed as soon as the forest authorities permit. Tofino Mines is financed and managed by Moneta Porcupine Mines, Ltd., and the latter will be re-imbursed for all expenditures before any declaration of profit. Privateer Mine, Ltd., is to receive its original investment of $50,000 out of 5% of net smelter returns.

Cellardor Mines, Ltd., has been incorporated to acquire and develop 53 claims seven miles south of Duncan on Vancouver Island. The property includes such well-known claims and former producers as the King Solomon, Bluebell, and Koksilah. The company is capitalized at 5,000,000 shares, of which 850,000 shares have been issued for properties. Mr. B. W. W. McDougall, the consulting engineer, has recommended an immediate programme of diamond drilling and bulk sampling.

New Westminster.—All operations of Western Nickel, Ltd., at Choate, have been suspended because of modification and partial cancellation of European sales contracts. The operation was commenced early in 1958 and reached capacity performance at the end of April. Concentrate was shipped to the Sherritt Gordon refinery at Fort Saskatchewan, Alberta. Mining and milling were done under contract by the Granby Consolidated Mining, Smelting and Power Co., Ltd.

Lillooet.—Bralorne Mines, Ltd., has reported the production of 23,570 oz. of gold, valued at $825,020 ($35 per oz.) from 36,261 tons of ore averaging 0·65 oz. of gold per ton during the second quarter of 1958; for the first half of the year the aggregate is 47,474 oz. from 72,470 tons averaging 0·655 oz. per ton. Development work has shown the prolific "77" vein to be longer and wider, although not quite so rich, on the 33 level than on the 32 level, on which it was found to average 1·15 oz. of gold per ton for an average width of 7·3 ft. for a length of 1,009 ft. At the lower elevation the vein is 8·1 ft. wide, 1,112 ft. long, and assays 1·0 oz. per ton.

Although ore reserves estimated at March 31 last at 205,523 tons grading 0·484 oz. of gold per ton declined by 91,577 tons in the year prior to that date, the annual meeting of shareholders of Pioneer Gold Mines of B. C., Ltd., was informed that no ore in the new "92" vein has yet been blocked out sufficiently for inclusion. In limited driving to date on the 25 level this vein has been found to be 2·5 ft. wide with 0·75 oz. of gold per ton. A further cross-cut of 1,000 ft. is expected to reach the "89" vein as indicated by diamond drilling.

Kamloops.—The position of diamond-drill holes now being driven by Phelps Dodge Corporation of Canada, Ltd., on the Highland Valley property of Jericho Mines, Ltd., is clearly shown on an information bulletin issued by the last-named company. Three holes, one of which is well advanced, are now drilling in the easterly section, close to properties held by New Jersey Zinc and Ventures. Three further holes are to be put in in the south-western corner of the 1,000-claim holdings in a location largely surrounded by Kennecott claims. A large coloured map in the bulletin shows the position of all the major companies in the Highland Valley copper-belt. Jericho directors anticipate early reports from Phelps Dodge on progress in the drilling programme.

Northwestern Explorations, Ltd., a subsidiary of the Kennecott Copper Corporation, has a crew of 20 men engaged in exploration on the Krain group of Beaver Lodge Uranium Mines, Ltd. The work is to be followed by diamond drilling. Northwestern Explorations has also agreed to examine the Outrider group of Beaver Lodge, adjoining the main claims of Bethlehem Copper in the Highland Valley and has appropriated $10,000 for preliminary work. Beaver Lodge's gold-silver mining venture in the State of Colorado is somewhat behind schedule owing to the necessity of boring a 15-in. hole from surface to the working face at a depth of 1,700 ft. to provide ample air for the operating crew, as required by law. The churn-drill hole has currently reached a depth of 1,450 ft. The Colorado project is owned 70% by Beaver Lodge and the balance by the Contract Engineering Co., of Denver, the managers in charge of the work.

Torwest Resources, Ltd., has acquired a 15-claim prospect in the Mattagami district of northern Quebec. The claims are situated a short distance from the Mattagami Syndicate's important base-metal discovery and five miles from the New Hosco discovery. A senior consulting firm has been retained to make an examination and recommend an exploratory programme. Torwest is continuing with its electro-magnetic survey and is preparing for a drilling programme on its 14-claim property south of the Craigmont mine in the Merritt area. Drilling by Noranda Mines, Ltd., in close proximity to two sides of the Torwest ground is of particular interest. Canadian Exploration, Ltd., is working on a third side. In the Highland Valley Torwest has a 48-claim group under option to Noranda and is retaining another group of 50 claims. The company is hopeful of receiving early revenue from its oil-drilling operations on the north shore of Lake Erie in Ontario.

Alscope Explorations, Ltd., has acquired 32 mineral claims in the copper-belt south-east of Merritt. A magnetometer survey is to be undertaken at once, the company being amply financed for this and other undertakings in hand.

An extraordinary meeting of shareholders of Craigmont Mines, Ltd., on July 29 approved the action of directors in entering an agreement whereby Canadian Exploration, Ltd., Noranda Mines, Ltd., and Peerless Oil and Gas Co. will be enabled to acquire a 60% interest subject to the performance of development work carrying through to production. In answer to a question Mr. J. D. Little, the engineer in charge of work being done on the Craigmont property by Canadian Exploration and also a director of the Craigmont company, said hole No. 18 had disclosed a vertical section of 120 ft. carrying 4% *plus* in copper, with an average of slightly over 2% for a greater length. Below the 3,000-ft. horizon he said the mineralization had greatly decreased.

Shareholders of the Makaoo Development Co., Ltd., have approved the cancellation of the agreement between the company and W. D. Heller and Associates, of Montreal. The latter failed to perform work as required in the agreement on Makaoo's property near Kamloops. The Makaoo company will endeavour to raise sufficient funds to resume its own development programme, which had been unfolding encouragingly prior to the advent of the Heller interests.

Ainsworth.—The annual meeting of shareholders of Western Mines, Ltd., approved the conversion of the company's capital structure into 3,000,000 common shares of a par value of $2 each. Payment has been made to the Consolidated Mining and Smelting Co. of

Canada, Ltd., of 193,790 shares in full settlement of all work performed and 150,000 shares for the Highland mine, which has been incorporated into the holdings of Western Mines, The total issued stock of the company stands at 1,205,043 shares.

Slocan.—The development of the New Denver property of New Santiago Mines, Ltd., from a sub-level leading from a winze below the 6 level is currently yielding very encouraging results. Mr. R. Crowe-Swords, the company president, reports that a band of galena from 6 in. to 10 in. in thickness is clearly outlined on the hanging-wall and has returned the following assays from representative samples : 109·1 oz silver with 80·2% lead ; 104·7 oz. silver, 81·4% lead, and 1·9% zinc ; 93·6 oz. silver, 81·3% lead ; 71·05 oz. silver, 19·3% lead, and 11·5% zinc, and 107·5 oz. silver, 23·8% lead, and 16·4% zinc. The occurrence is believed to be an extension of the main Bosun lead from which the greater part of production has been taken to date.

TORONTO

August 15.

Gold Production.—The output of the gold mines of Ontario for June included 228,960 oz. of gold and 42,275 oz. of silver, valued at $7,740,144, recovered from 775,140 tons of ore milled. For the first six months of the current year the Province's thirty producing mines reported milling 4,675,262 tons containing 1,345,182 oz. of gold and 220,777 oz. of silver valued at $45,859,408.

An increase in the subsidy certain gold producers receive under the Emergency Gold Mining Assistance Act has been foreshadowed by the Finance Minister, Mr. Donald Fleming. The increase, stated to be of 25%, is to be applicable to the full current calendar year and for two years thereafter. It will amount, it is estimated, to $2,500,000 for 1958 and raise the year's total subsidy to some $12,500,000. The necessary Bill has yet to come before the House of Commons.

Canada's Mineral Industry.—A study prepared by Dr. John Davis for a Royal Commission on Economic Prospects concludes that by 1980 minerals may comprise a third of Canada's exports, the value by then rising to $5,500,000,000 a year, as compared with the 1955 figure of $1,600,000,000. In 1955, it is stated, foreign interests controlled 55% of the Canadian mineral industry ; by 1980 this may well have risen to 66%. It is noted that Canada has about 40% of the world's asbestos reserves (enough for 56 years), more than 15% of the world's reserves of copper (sufficient for 45 years at 1955 production rates), 6·2% of the world's iron (enough for 250 years), 23% of the world's lead (good for 50 years), 40% of the nickel (good for 35 years), 29% of the zinc (sufficient for 54 years), and more than 20% of the titanium (sufficient for 400 years). Notwithstanding these substantial reserves, the report says, the search for new metals must be pressed in order to supply the greatly-increased demands for the future as Canada's own and the world's population increase and living standards rise. In addition it is necessary to create reserves in minerals and metals in which Canada is deficient and to find sources of metals and minerals not needed now but that may be of increasing importance in the future " as was true of uranium a few years ago."

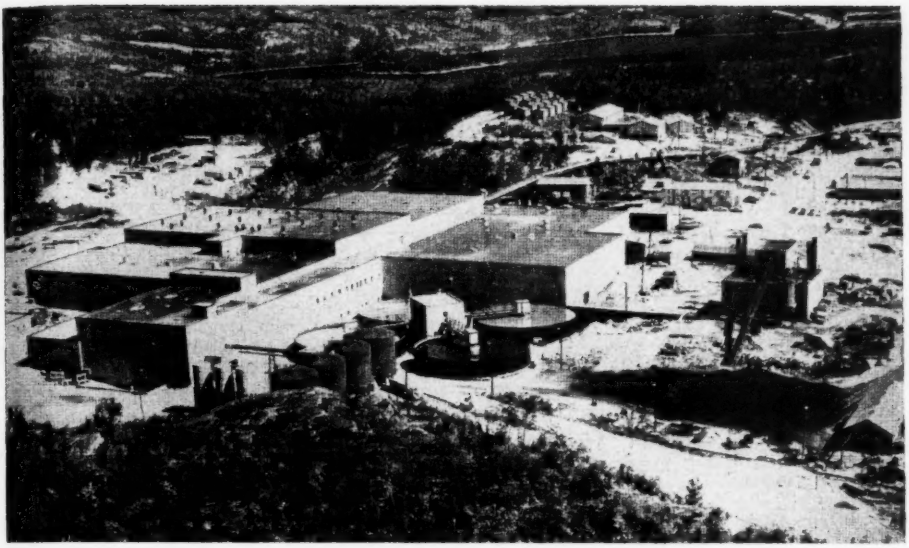
Kirkland Lake.—It is reported by Wright Hargreaves Mines that development work at the lower horizons of the property is providing encouraging results. Early in June it was stated that 1,423 ft. of new ore had been opened up averaging 0·70 oz. in gold per ton across a mean width of 5·4 ft. Development was about equally distributed over three levels at 7,800, 7,950, and 8,000 ft.

Bancroft Area.—In the first five months of the current year Faraday Uranium Mines milled 192,791 tons of ore, 23,606 tons of which was on a customs basis for Greyhawk Uranium Mines. The profit for the period is given as $973,938.

For the same period Bancroft Uranium reports an operating profit of $1,741,587, output for the five months being valued at $3,828,976.

Cobalt.—Agnico Mines (formerly the Cobalt Consolidated Mining Corporation), which obtains feed from several individual operations including the recently acquired Nipissing O'Brien Mines' holdings, had an estimated output of 142,000 oz. for May, the highest since the new mill commenced operation. Production for the first five months of 1958 totalled 580,050 oz., of which 136,861 oz. was recovered in March and 130,469 oz. in April.

Manitouwadge.—In the six months to



Mill at Consolidated Denison Mines.

June 30 last Geco Mines milled 636,271 tons of ore, the estimated profit on operations being $1,669,200. In a report to shareholders the company president, Mr. N. C. Urquhart, says that at the mine exploration drives and diamond drilling therefrom are being extended west on the 850 level and east on the 1,050 and 1,250 levels. At the end of the month the drive on the 850 was approximately 2,000 ft. west of No. 1 shaft and diamond drilling near the face had intersected copper mineralization over 10 ft. and 19 ft. widths. At the same time the 1,050 level drive was advanced to approximately 975 ft. east of No. 1 shaft and diamond drilling has confirmed ore in reserve at the end of 1957, as well as extending the known ore-zone on this level by outlining 500 ft. of good-grade ore to the east. In addition the 1,250 level drive east had been advanced to approximately 385 ft. east of the shaft and diamond drilling from this level had also confirmed ore in reserve at the end of 1957, the grades and widths being up to expectations.

Alberta.—From September 17 onwards many visitors are expected in Edmonton to attend the National Conference of Northern Development. This, sponsored jointly by the Edmonton Chamber of Commerce and the Alberta and Northwest Chamber of Mines, is being called to discuss the future of Canada's expanding north country. A special feature is to be a discussion on present and potential development of northern Canada as related to the future economic development of North America. Other special sessions will deal with planning for orderly development of the north and subjects of talks will include everything from "Living in the North" to "The Canadian North—A Prophecy." Panels are to deal with such specific matters as the north country's mineral potential, oil and gas resources, forest products, and energy resources.

Manitoba.—Development in the north of the Province will be aided by two roads scheduled for construction at a cost of $15,000,000. They are to be built over the next three years and will be financed jointly by the Manitoba and Federal governments. One road, to skirt the east shore of Lake Winnipeg to the narrows, will be extended in a north-easterly direction to Gods Lake. The other will involve construction from Simon House, north of The Pas, to Snow Lake and the Thompson site of the International Nickel Company's Manitoba development. Eventually the road is to be extended to the Seal River area.

The Department of Mines and Technical Surveys, Ottawa, has published two aeromagnetic maps covering part of the Seal River area. The maps, on a scale of 1 in. to the mile, are designated 669G, Ryan Lake Area, and 670G, Wilkie Lake Area.

It is expected that North Rankin Nickel Mines will be able this summer to ship 17,000 tons of nickel-copper concentrates to the Sherritt Gordon refinery at Fort Saskatchewan, Alberta. Despite current low base-metal prices it is believed operations are being conducted at a profit. During the first quarter of this year the North Rankin profit was $79,172.

Quebec.—It has been announced by the Provincial Department of Mines that the current year's mapping programme for the Geological Survey is the largest ever undertaken by the Department. Parties are at work in sections extending from the southern limits of Quebec to far northern parts bordering Hudson strait and from the Ontario border eastward to Gaspé and the lower North Shore of the Saint Lawrence. About 5,000 sq. miles are to be mapped on a scale of 1 mile to the inch, while reconnaissance mapping will cover an additional 3,000 sq. miles in the Cape Smith-Wakeham Bay mineralized belt of Ungava and in the Matapedia-Rimouski area.

In the six months to June 30 last the Quemont Mining Corporation milled 424,700 tons of ore and made a profit of $661,000. The earnings during the period were seriously affected, it is stated, by decreases in the prices of metals since the first of the year and the continued high rate of exchange on United States funds, currently at approximately 4%.

It has been announced that a group composed of Noranda Mines, McIntyre Porcupine Mines, and Canadian Exploration, Ltd., has taken an option on the Main property of the Mattagami Syndicate. The Syndicate is composed of Leitch Gold Mines, Teck-Hughes Gold Mines, Dome Mines, Highland-Bell, Iso Uranium, and Area Mines. Under the terms of the agreement the Noranda-McIntyre-Canadian Exploration group is committed to spend $400,000 within a year and a half on a 30-claim property in Galinee township. Work done so far on this property consists of 37 diamond-drill holes totalling 22,652 ft. This drilling has indicated some 14,000,000 tons of ore averaging 11·5% zinc, 0·65% copper, and 0·16 oz. gold and 1·1 oz. silver per ton.

MELBOURNE

August 20.

Peko Mines.—Peko Mines, the Northern Territory's copper producer at Tennant Creek, is again on the dividend list, following a lean period resulting from the fall in the price of copper. The net profit has recovered from £A42,930 to £A130,814 in the year ended June 24, 1958. Copper output for the year was 7,486 tons, an increase of 41% on the previous year's production. The profit resulted after provision of mine working costs amounting to £A902,013—an increase of £A217,857, including redemption and ore replacement allowances of £A217,156.

The mine has been opened up to a depth of 1,000 ft. and ore reserves approximate 1,000,000 tons. In the year just ended 109,418 tons of ore were treated for the recovery of 29,809 tons of copper concentrate assaying 25·11% copper and 0·438 oz. of gold per ton. Average value of the mill feed was 7·38% copper, which may be taken as representing that of ore reserves; mill recovery was 92·71% of the copper. This is the highest-grade underground copper mine in Australia and an interesting fact is the unbroken continuity of the copper ore-body to a depth of 1,000 ft., whereas most gold shoots on the field end between 100 ft. and 130 ft. Two have exceeded 300 ft. from surface—the Australian Development mine at 305 ft. and the Eldorado Mine at 400 ft. Recent diamond drilling in the western part of the field has intersected ore, 20 ft. wide, assaying over 1 oz. of gold per ton, at a depth of 400 ft. The success of the Peko mine led to diamond drilling of other mines in the search for copper, but without success.

Gold Production.—Figures for the Commonwealth production of gold for May showed an increase on the previous month, the total being 90,209 fine oz. as compared with 81,843 fine oz. in April. Western Australia produces 75% of the output. Value of the gold production this year is £A3,721,867.

The Morning Star (G.M.A.) mine, which was once an important Victorian gold producer, has been working in a lean zone for a considerable time, prospecting quartz reefs intersected by diamond drilling below 2,000 ft. from surface. The gold is coarse and diamond-drill intersections are regarded as valuable for evidence of structure and reef occurrence, but are disregarded as an indication of values. Reefs intersected must be explored by the usual exploratory methods

and this exploration has been unsatisfactory during several months past, but high-grade ore is now being developed in a reef at No. 20 level. A length of 246 ft. has been driven and the average grade is 30·4 dwt. over a width of 72 in. A rise is up 92 ft. in ore averaging 36·4 dwt. over a width of 72 in. The results are regarded as very satisfactory and suggest that the barren zone has been passed through and a good-grade ore may be found in the lower levels of the several reefs. The grade of the development ore has raised the mill recovery to nearly 1 oz. gold per ton.

Tinplate.—The new tinplate enterprise of the Broken Hill Proprietary Co., at Port Kembla, New South Wales, is making rapid progress. Production for the year so far has been above 5,000 tons of tinplate per month and over the past four monthly periods the monthly average has been about 5,700 tons, which, if maintained, will make the yearly output about 69,000 tons. Estimated full plant capacity is 70,000 tons per year. Work was commenced by the plant in August 11 months ago and the total production in that period has been 44,987 tons of plate; this was well below capacity because of the gradual building up of the output as the plant was run-in.

Broken Hill.—Effects of the 10% voluntary cut in production by the Broken Hill mines are shown by the figures for the first six months of 1958 for the Zinc Corporation and New Broken Hill Consolidated. Figures for North Broken Hill showed a reduction in the throughput of ore, but a steady output of lead and zinc. Production by Broken Hill South has been practically unchanged. In the six months concerned the Zinc Corporation treated 311,488 tons of ore for the production of 50,690 tons of lead concentrate and 54,274 tons of zinc concentrate. In the comparable period of 1957 346,150 tons of crude ore were treated and recoveries were 55,259 tons of lead concentrate and 62,734 tons of zinc concentrate. New Broken Hill Consolidated in the first half of 1958 treated 259,792 tons of crude ore and recovered 37,646 tons of lead concentrate and 58,143 tons of zinc concentrate. In the same period of 1957 310,220 tons of crude ore were milled and recoveries were 55,585 tons of lead concentrate and 66,825 tons of zinc concentrate.

Bulolo Gold Dredging.—The great days of this New Guinea gold-dredging company are ending. In the good years the company had eight bucket dredges working and of these only one is in operation, with sluicing plant on the terrace ground; a year ago two dredges were at work. In the year to March 31, 1957, 8,246,000 cu. yd. of ground were treated and 51,827 oz. of gold recovered, but in the year to March 31, 1958, ground dredged had decreased to 5,456,000 cu. yd. and gold recovery to 23,939 oz. The fall in net profit for the year to May 31, is estimated at about $490,000 Canadian.

Great Boulder Gold Mines.—This great gold mine, now an Australian company, has an impressive record and is one of the big mines in the Commonwealth, although at the beginning of the 1930's it was considered merely a tributing proposition. In the first year of operation as an Australian company Great Boulder treated 511,359 tons of ore (The year ended on June 30.) for the recovery of 124,392 fine oz. of gold and 39,408 fine oz. of silver. The value of the bullion recovered was £A1,956,833 and the head value of the ore treated was 5·32 dwt. gold per short dry ton. In the calendar year 1956 the mine treated 489,494 short dry tons of ore for 124,604 oz. of gold, worth £A1,962,393. Of the tonnage treated in the period just ended, 480,191 tons of ore were from stopes and 31,168 tons from development.

Exploratory work for the year under review totalled 14,058 ft., of which 4,762 ft., or 29·5% was in payable ore assaying 4·0 dwt. gold or over per ton. Good-grade ore has been developed in all parts of the mine and results are comparable with those of previous years. Important occurrences of ore have been opened up even at shallow levels.

Sons of Gwalia.—Recent results from the Sons of Gwalia, another old Western Australian mine, are encouraging to those who are watching for a come-back. For some time losses have been made, but the Western Australian State Government has assisted the company in this difficult period and it is gratifying that results for the four weeks ended July 8 are the best for a considerable time. At No. 27 level driving for 62 ft. gave a grade of 3·4 dwt. over 96 in.; at No. 26 level a rise to a height of 86 ft. was in values of 12·7 dwt. over 72 in. Rising at No. 25 level was in ore averaging 8·4 dwt. over 72 in. for a distance of 272 ft., and in a second rise from the same level values for 17 ft. were 9·4 dwt. over a width of 72 in. No. 4 east drive at No. 25 was in ore from 0 ft. to the face at 26 ft. worth 9·4 dwt.

over 96 in. Rising was in progress at No. 24 level in 6·3 dwt. ore over 72 in. for a height of 71 ft. and a second rise had shown ore assaying 5·4 dwt. for the 12 ft. risen. Driving at this level for a distance of 43 ft. had shown values of 4·9 dwt. over 96 in.

Oil Search.—For 20 years the search for oil in Papua has been continued and an expenditure of £A30,000,000 incurred. Although there have been encouraging factors from time to time there has been no success. The active companies are Australasian Petroleum Co. Pty., Ltd., Island Exploration Co. Pty., Ltd., and Oil Search, Ltd. Associated with these companies are the Vacuum Oil Co. and the B.P. Exploration Co.; these two companies have decided that they will not provide further capital unless material encouragement is given from the current programme of drilling. As a result of this decision, it will be necessary for the three Australian companies to find new partners if the search in Papua is to be continued. The Vacuum Oil Co. and British Petroleum Co. hold 45% of the capital in the group and if new partners cannot be found work must cease on completion of the present wells, which have not yet given the encouragement necessary to retain the two overseas partners. Gas has been found in quantity in two bores, which is considered to be a potential asset. In recent work two bores reached depths of 9,977 ft. and 13,862 ft., with gas present in the deeper bore.; the two bores now in progress have reached depths of 9,700 ft. and 5,500 ft.

In South Australia renewed effort is to be made in the search for oil in the north-east of that State and the south-west of Queensland. Initial work was carried out by Santos, Ltd., an Australian company, which located showings of light oil and of waxy material at several localities over a wide area of rocks forming the Great Artesian Basin. This company has now joined forces with the Delhi-Taylor Oil Corporation of Texas, the name of the new organization being Delhi Australian Petroleum, Ltd. The company is commencing intensive seismic and geological survey of an area of 50,000 sq. miles around the border of South Australia and Queensland preliminary to selecting the site for a test well which may be drilled to a depth of 14,000 ft.

The Commonwealth Government is to make tax concessions to assist in encouraging the search in Australia; hitherto, a remission of tax on one-third to the sum paid in calls to exploratory companies has been in force, but this is to be extended to 100% of the amount so paid. Whether this concession will be extended to Australian and overseas companies operating in Papua is not known at present.

New Zealand was an oil producer in the earlier years of the century, but this active period has been followed by many years of inactivity. For several years past the Shell Company of New Zealand has been carrying out exploratory work in the Taranaki district of the North Island, where oil was previously produced. In the course of this work possible oil traps were located by seismic methods. This work has not yet been completed, but it has been announced that full-scale drilling is to be commenced at Inglewood early in 1959. Heavy drilling equipment is being brought from Borneo and will reach New Zealand early in October. To date the Shell Company has spent £1,000,000 on exploratory work in the region and this has outlined two areas, Inglewood and Manaia, as containing attractive structures. The original productive area was at Moturoa, New Plymouth, where a number of wells produced intermittently since 1866, but the output of about 30,000 gal. per month in the recent years of the field was low.

Diamonds.—The Western Australian Government has granted a temporary reserve of 10 sq. miles in the Mount Hahn area of the Kimberleys for prospecting for diamonds. The formations to be examined are blue clays. Diamonds were first found in the State at Nullagine in 1895; they were of good quality but small and of little commercial value. In New South Wales diamond mining in alluvials was active for a number of years and fair production was achieved. The stones were small and of high quality, although their size was against their use in jewellery. It is stated that the hardness of the stones was rather greater than normal. In one locality only were diamonds found in rock, the deposits being invariably alluvial leads with cassiterite or gold in association. Small but attractive stones were recovered by the dredge of Wellington Alluvials, Ltd., on the Macquarie River, New South Wales, which has recently closed down.

South Australian Uranium.—Search for uranium ore in South Australia has been negligible as the result of the Government policy of reserving all rights in uranium to the Crown. The State enterprise at Radium Hill and the treatment plant at Port Pirie

appear to be successful enterprises, but the Government has been unsuccessful in an effort to interest private enterprise in the Government-prospected uranium field further north from Radium Hill, at Crocker's Well, and Victoria Hut. A new find of high-grade ore by a prospector near Olary has been reported. The finder has been advised by the Department of Mines to apply for the reward for discovery of radioactive ore in lodes capable of economic exploitation.

FEDERATION OF MALAYA

August 17.

Tin Industry.—An investigating committee is to look into the economic situation of the State of Selangor's 3,238 dulang washers. This has been decided by Inche Bahaman bin Samsuddin, the Federation of Malaya's Minister for Natural Resources. His decision followed a meeting which he had with officials of the Malayan Chinese Association who submitted the appeal of the dulang washers against the cut in their tin production quota from 25 katies to 15 katies per month. The committee will only investigate the position of the Selangor dulang washers, it is understood, even though the cut is nation-wide. According to a Kuala Lumpur report the Selangor dulang washers are the only ones who have protested.

Following the International Tin Council's decision to impose a further cut on exports by producer countries of the International Tin Agreement more mines will soon be forced to close in Malaya. The new cut applies to the last quarter of 1958. The latest cut has induced the Perak Chinese Mining Association to urge that the Malayan Government should provide financial aid for tin miners. The most recent figures show that since last December, when tin production was first restricted, 10,722 mine workers have lost their jobs in Malaya. This number is the difference between the December mine labour force of 36,585 and the June labour force of 25,863. By the end of June 449 tin mines were operating—made up of 46 dredges, 349 gravel pumps, and 54 other types of mine. This, compared with the May total of 447 mines operating, revealed an increase of two mines, a further eight dredges and four other other mines being closed and 14 gravel pump properties re-opened during June. At the end of last December 738 tin mines were working in Malaya.

Opposition has been voiced in Malayan mining circles to the admission of Russia to the International Tin Council as an " observer member," following a report from London that Russia had rejected a request by the tin council to become a producer member. The Russians, according to London report, had argued that they were substantial importers of tin as well as exporters and were willing to send observers to the council meetings " to discuss the state of the international tin market," but not to join as producers. Mr. K. J. Cumming, president of the F.M.S. Chamber of Mines, speaking in his personal capacity, is reported in Ipoh to have said : " If Russia were to become an observer, I cannot see how producer participants in the international tin agreement would benefit. What we want is a decision from Russia at the very earliest as to whether she is prepared to become a producer participant in the international tin agreement, which she has been requested to do by the council. If Russia were to become an observer she would be in a position to obtain certain information which that country may use to further aggravate the position as far as producer participants are concerned." Mr. Woo Ka Lim, secretary of the Perak Chinese Mining Association, who is also a member, representing Chinese mining interests, of the Federal Legislative Council, is quoted as having said that there was no provision in the International Tin Council constitution for observers. As an observer Russia would be able to get into the council without having to observe the tin export restrictions.

A Chinese contractor is reported to have struck tin at the Sungei Batu Ferringhi, in rural Penang, 11 miles from the city of George Town. He has applied for permission to recover the tin from land which is State property. Mr. A. B. L. Clark, the Collector of Land Revenue, said in Penang that the application had been referred to the Chief Inspector of Mines, Northern Zone. It was too early to assess the value of the find, he added. No tin mine has so far operated in Penang Island.

Seabed Oil.—The Shell Company of North Borneo has abandoned the exploration well being drilled at sea at Hankin Shoal, about 30 miles north of the northern tip of Labuan island. No indications of the presence of oil were found after the well had been drilled to a depth of 9,000 ft.

This was the first high-seas exploration well in the North Borneo area. It was part

of the general marine programme of exploratory drilling planned by the Brunei Shell Petroleum Co., Ltd., the Sarawak Shell Oilfields, Ltd., and the Shell Company of North Borneo, Ltd. The object was to search for new oil-bearing structures along the continental shelf off the three British Borneo territories. Four wells were drilled, but the results to date have been negative. Nevertheless, the three companies plan to continue the search for oil by using a mobile drilling platform instead of the fixed platforms employed so far. One of these mobile platforms is being constructed in England and is due to arrive in Borneo early next year.

Pakistan.—A party of four Japanese geologists, sent by their Government, has been making an extensive tour of coal, chromite, and lead fields at various places in Quetta and Kalat regions with a view to the better exploitation of such mineral resources in Pakistan. The party is also to make a tour of mineral deposits in the Punjab, Chitral, and elsewhere.

The Pakistan Industrial Development Corporation has placed an order with a Czechoslovakian firm for machinery and equipment for the expansion of the Maple Leaf cement factory at Daudkhel, West Pakistan. This expansion will raise the factory's output from 350 tons to 850 tons a day. The factory, which went into production in April, 1956, has produced more than 210,000 tons of cement so far.

Steel Plant for India.—The Indian Government has made provision of Rs. 50,000,000 to be spent in 1958–9 on preparatory work for a fourth state-owned steel plant. Such work would cover planning of a township, construction of main roads, accommodation for construction staff, and the building of offices. The consulting engineers to the Department of Iron and Steel, New Delhi, have recommended the siting of such a steel plant at Bokaro, Bihar, with a capacity of 2,500,000 tons to 3,000,000 tons annually.

Oil in China.—China has launched a second five-year plan which aims to increase oil production from the present 1,500,000 tons a year to 6,000,000 tons. The first five-year plan gave a great boost to production and brought the vast Karamai oilfield in northern Sinkiang into operation. Under the new plan the intention is to increase production at Karamai to 3,000,000 tons a year by 1962. At the same time 200 smaller fields found by prospectors are to be opened up and test drillings made in the Gobi desert. Further drillings are to take place in the established Yumen, Szechwan, and Tsaidam Basin fields.

Small and medium-sized refineries are to be built in more than 100 areas where oil-bearing shale has been found in the open.

JOHANNESBURG

August 28.

Mineral Resources.—In his annual review of the mining industry the Minister of Mines (Dr. A. J. R. van Rhijn) mentioned that the Council for the Development of Natural Resources is surveying the Pretoria-Johannesburg-Vereeniging complex with special attention being paid to those centres eventually to be affected by the closing of gold mines.

While the Union was maintaining its position as a diamond producer it was desirable that its relative position should be improved. Accordingly, large-scale prospecting on private ground was being encouraged and, through the Department of Mines, the Government was investigating Crown lands south of the State diggings at Alexander Bay at a cost of £750,000. Operations at these diggings had been considerably expanded, to which the recently-completed £500,000 recovery plant was greatly contributing.

In addition to its contracts with the Combined Development Agency for the supply of 6,200 tons of U_3O_8 a year, a considerable tonnage would be sold direct to the United Kingdom. Furthermore a sales committee had been established under the Atomic Energy Board to handle other sales.

Inquiries overseas by a representative of the Department had elicited the information that the declining demand for base minerals and mineral ores would not suddenly be reversed.

Blasting in Collieries.—The mechanics subdivision of the Council for Scientific and Industrial Research has been investigating the application of millisecond blasting to coal-mining operations, particularly in respect of its having a less deleterious effect on the condition of the roof strata than conventional blasting. In the latter the procedure is time consuming, requiring that the miner enter twice into a fairly dusty and contaminated atmosphere; it also involves a drill round of three horizontal blast-holes, two above and one below the horizontal cut made by the coal-cutter in the seam, the

lowest row being fired first, then the middle, and finally the highest row. In millisecond blasting the drill round is the same, but the charges are all wired up at the same time, the lowest row being fired first electrically, and the second and, finally, the highest row being fired 25 and 50 milliseconds, respectively, after the first. This important condition must be adhered to—namely, that the total time of firing should not exceed about 90 milliseconds. A greater period would promote ignition of the explosive gases released in the first firing by the flash of the third. The re-entry occurs after firing has been completed and the working area is free of dust and fumes.

To determine the effect on the roof and overlying strata from both conventional and millisecond blasting vibration pick-ups were attached as near as possible to the roof of the workings close to the face and in the surface ground 400 ft. above and in the same vertical plane as the face. The recording showed that the effect of the three rounds of millisecond blasting was only slightly greater than one round (or row) blasting of the conventional method. In effect the short duration of the former propagates only one shock wave against three in the latter, all three being of about the same intensity. The tests were conducted in the Sigma Colliery of the oil-from-coal project at Sasolburg in the Northern Free State, which now has adopted millisecond blasting as standard practice.

Union Economy.—In his annual review of economic and financial conditions in the Union the Governor of the S.A. Reserve Bank, Dr. M. H. de Kock, commented that available information seemingly indicated a reduced rate in growth of the national income in the year to June 30, due largely to lower farm incomes. With mining expansion slowing down, the trend in secondary industries somewhat erratic, and trade and commerce recording greater activity, public body and Government expenditure was yet substantially higher. Answering the question why imports have continued to advance in the face of declining exports and reduced private fixed investment, the Governor pointed to: The anticipation of increased or continued high consumption following the high increase rate in the 1956/57 national income, the continuation of high investment levels by the Government and public bodies, a backlog in demand for supplies, exceeding estimates, especially in motor vehicles, fears of re-intensification of import controls arising from the decline in gold and exchange reserves, relaxed hire-purchase terms in 1957 in respect of motor vehicles, and an abnormal increase in commercial bank credit and in the velocity of circulation of money (which probably was caused by intensified efforts to maintain profits by increasing turnovers). To reverse the bank credit trend the commercial institutions were required to establish supplementary reserves with the Reserve Bank of 4% or £20,000,000 by the end of July, or to invest an equivalent amount with the Land Bank, in Treasury Bills, or short-term Government stock, and/or with the National Finance Corporation. In other words, the banks were given the option to divert funds from the private sector to the public or Government sector—that is, to contribute in greater measure to the official or Government capital expenditure programme, particularly on railway and harbour development. Thereby it was intended to reduce the amount of credit for consumption, while not interfering with that for productive purposes. More recently the maximum level of 10% has been imposed for the supplementary reserves—*i.e.*, an additional 6% or £30,000,000 on the above basis by the end of November. This last increase seems specifically directed to make adequate funds available for the Government capital expenditure programme, as well as to arrest inflationary effects and the regeneration of further credit in the private sector arising from the Government spending. It is therefore understandable that, while the State has attempted to stabilize interest rates by maintaining the Bank rate, rates on the open market have tended to harden and in some cases have been allowed to do so. To strengthen the reserves, which should benefit from the measures already mentioned, reliance is placed on broader controls on exchange transactions, on restrictions on local authority borrowings, re-intensified motor-vehicle hire-purchase terms, increased excise and customs duties on certain supplies, and the lower British Bank rate.

Railways.—In his Railways Budget address for 1958/59, the Minister of Transport repeated a previous comment that, while the 1957/58 year had been one of great difficulties partly through climatic interference with services, the final figures reflected an increase in freight carried of over 2,000,000 tons. In the 1958/59 year

declines in certain commodities carried are expected to be offset by greater offerings of coal and iron ore. So far the long-term contracts for exports of chromite and manganese ore have not been affected materially by weakness in the mineral markets and there has not been any noticable reaction on truck requirements. Future railings will be contingent on new business in these minerals and on the willingness of producers to sell at prevailing low prices. However, particularly in respect of chromite, the suspension of output by some producers will liberate truckage that would be made available to those with long-term contracts. Consequently railings of these ores for export should be maintained in 1958/59 and any revival in the mineral markets will mean transporting heavier tonnages.

Over the last three years or so £201,250,000 have been expended on new lines, new works on open lines, and the purchase of rolling stock and other equipment. Nevertheless the backlog in transport facilities has been such that, despite the recent slackening of economic activity, the aggregate traffic has risen to new high levels. In the 1958/59 year expenditure will amount to £78,900,000. The capital expenditure and betterment programme, which at present involves about £315,000,000 in the period ahead, is expected to be largely completed by the end of 1961, when the railways should be able to meet all demands.

The harbours have also been handling record tonnages and continued expansion including introduction of mechanical-handling appliances will in 1958/59 involve expenditure of £2,800,000.

Mine Labour.—The Mine Workers' Union, alleging infiltration of non-Europeans into certain categories of work previously almost exclusively performed by Europeans and in some cases by disabled European underground workers, is seeking the application of job-reservation to the gold mines. Job-reservation involves the declaration of certain categories of work as reserved essentially for Europeans or non-Europeans.

A conciliation board is considering claims for general increases in basic wages of all daily-paid workers in Transvaal and Free State collieries.

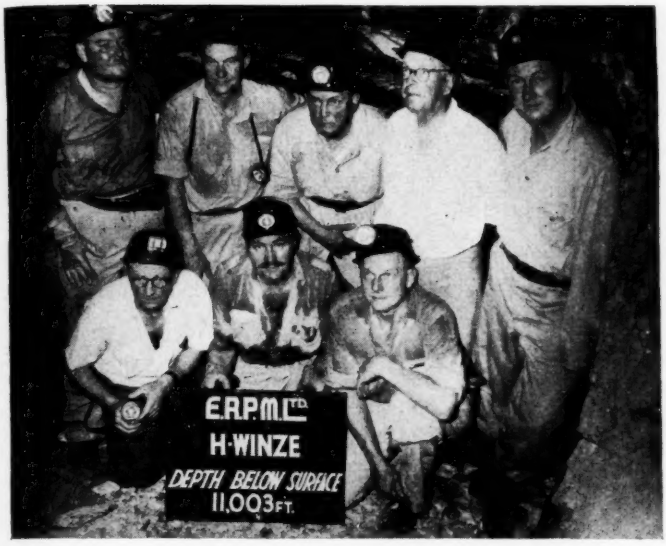
Artisans on the gold mines have submitted claims for higher wages to the Gold Producers' Committee of the Chamber of Mines.

Deep Mining.—East Rand Proprietary Mines, Ltd., and Boksburg, which has always been easier to get into than out of, remain practically synonymous notwithstanding the many successful manifestations of industrial progress on the eastern outskirts of the town, especially now that the mine has in its turn successfully advanced its own peculiar operations to the world record depth of more than 11,000 ft. The only ghosts that are therefore likely to be encountered in the area for years to come are those liking to get a little of their own back on the stretches of road which in the less recent past provided the town with a supplementary source of revenue—traffic fines—to a degree that the Reef towns further east from Johannesburg must at times have envied.

On August 8 the prolonging of the association of mine and town and the achievement of the record were celebrated by the Mayor, Councillor J. F. P. Badenhorst, and representatives of the Council and its staff, the general manager of the company, Mr. D. MacNiven, and the mine staff, representatives of the head office (C. W. Engelhard, G. V. R. Richdale, W. Marshall Clark, P. H. Anderson, F. G. Hill, A. R. C. Fowler, J. J. P. Dolan, and others), representatives of the Chamber of Mines and other mining groups, and representatives of technical societies, including Mr. H. Simon, President of the South African Institute of Mining and Metallurgy.

In presenting commemorative mementoes of the world record achievement to members of the staff employed in the Hercules section where the deepest operations had been advanced Mr. C. W. Engelhard commented that the achievement represented both a great technical step forward and courage on the part of the personnel of the mine.

Mr. P. H. Anderson, chairman of the company, then addressed the gathering on the features of the operations which had facilitated the advance to the depth of 11,000 ft. and which would, if, as looked probable, the grade held, take these still deeper to 12,000 ft. below surface at least. The main factors in the achievement are: Long-wall stoping, which has reduced the hazard of pressure bursts to negligible proportions and de-stressing operations prior to the start of the working shift, as well as better ventilation combined with more efficient control, expanded refrigeration or cooling of the air, and delivering the air to the working places at a high velocity. The importance of the ultra-deep operations



Mine Officers Underground at E.R.P.M.

for East Rand Proprietary Mines, Ltd., for Boksburg, and for the country's economy and finances are assessed in the estimates that each 1,000 ft. on the reef dip adds up to 10,000,000 tons of ore to the mine's potential and up to 2,500,000 oz. to the yield, which would have a value of more than £30,000,000.

Transvaal.—It is understood that the Johannesburg Consolidated Investment Company is preparing to float a company to exploit the Waterpan Block, which was intensively investigated recently but the immediate exploitation of which was deferred because of unfavourable market and general financial and economic conditions. The Block is about 18 miles south of Randfontein and east of the Venterspost and Libanon mines. In the Block 33 bore-holes were drilled; 24 intersected one or more of the reefs in the shallower Ventersdorp Contact and the deeper-lying Upper Elsburg Series and 16 disclosed payable values. The drilling delineated a compact zone, in which 18 bore-holes intersected reef and 16 disclosed one or more payable values, at depths of 2,650 ft. to 6,500 ft. below surface and below lava and sub-surface dolomite. The estimated tonnage in the compact zone is 68,000,000 tons, averaging 9·3 dwt. over 60 in., of which about 50,000,000 tons are in the Elsburg Series, averaging about 8·5 dwt. a ton and the balance of a slightly higher average in the Ventersdorp Series. After allowing for variations in reef values and dilution normal to productive operations the plant yield is expected to be about 5·5 to 6 dwt. a ton, of which working costs may absorb 3·75 dwt. or slightly more.

Zandpan Gold Mining Co., Ltd., in the Anglo-Transvaal group, which has not yet been publicly floated, is also understood to be contemplating a public issue of shares. Drilling has been completed in the projected lease area, immediately east of Klerksdorp town, and while values indicated a somewhat erratic mineralization over a wide range from low to high values the bore-hole values on the Vaal Reef horizon were not without promise. The depth of this reef increases from shallow in the west to deep (of the order of 7,000 ft. to 8,000 ft.) in the east. High values in the latter section became the cause of police investigation, but the outcome was inconclusive. Including the doubtful values, the average grade for the projected area ranged from about 10 to 15 dwt. over an assumed width of 40 in.; disregarding these values the average is about 5·5 to 6·5 dwt. over the same width, with indicated payability of 50% or slightly less. In the projected lease area of 5,539 claims the Buffelsdoorn Fault upcast the reef to as shallow a depth as 600 ft. to 700 ft. in the extreme western section; east of the fault, in the section that will contribute the greater tonnage, probably most of the tonnage, the depth ranges from

about 4,800 ft. The friable nature of the Vaal Reef is such that higher development values may well be expected than those indicated by drilling.

Winkelhaak Mines Ltd., now in the test-milling stage preliminary to the start of production proper early next year, is believed to be conducting milling tests in standard, large-diameter, wet-running mills on run-of-mine ore.

Bentonite.—The chemical division of the South African Council for Scientific and Industrial Research has reported on a clay sample identified as a calcium-magnesium montmorillonite, the deposit of which has been shown to be extensive and of an unusually consistent mineralogical composition, identical with that of the well-known bentonites of the southern regions of the United States. Synthetic alteration of the montmorillonite resulted in properties similar to Wyoming bentonite as a bonding agent for foundry sands.

Orange Free State.—Free State Saaiplaas Gold Mining in its more easterly No. 1 Shaft intersected the Basal Reef at a depth of 5,394 ft. below the collar, a complete exposure around the perimeter averaging 24·9 dwt. over 28·2 in. or 702 in.-dwt. The shaft, 24 ft. diameter inside lining, will be sunk to a final depth of about 5,700 ft. The No. 2 Shaft, 27½ ft. diameter inside lining, is situated about 4,000 ft. west of No. 1, is expected to intersect the Basal Reef at about 5,750 ft. early in 1959, and will be sunk to a final depth of 6,480 ft. Drilling results in and close to the lease area indicate an average grade for the property of 320 to 500 in.-dwt. which is somewhat lower than the No. 1 Shaft values. The two shafts are in the south-eastern section, which is apparently in a high-grade zone of the mine.

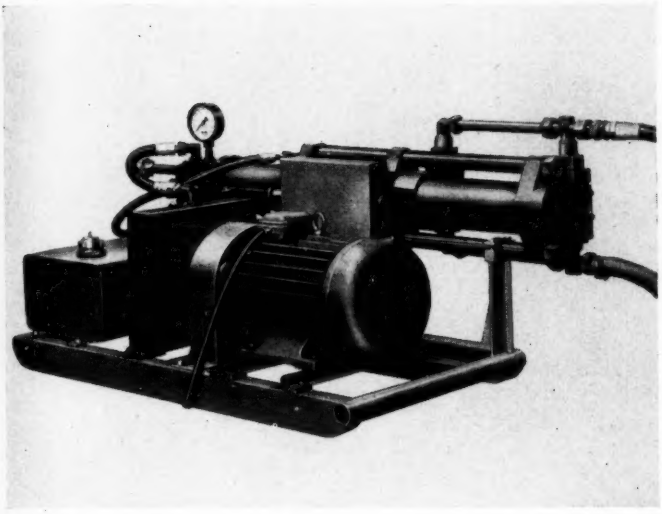
Central African Federation.—Commenting on the statistical position of copper the chairman of Nchanga Consolidated has stated that the present phase appears to be one of balance between supply and demand. The immediate future trend is difficult to determine, being dependent on so many factors—such as, the course of the current recession, actions of Governments, and producer attitudes. Because of present price levels the programme of economies and increased efficiencies involves continuous and thorough review of every aspect of the use of labour and machines at all levels of management and staff. The Northern Rhodesian copper industry expects better relations with employees to result from recently-enacted legislation, based on the findings of the Honeyman Commission, which, as the result of the dispute with rock-breakers last year, carefully assessed labour relations within the industry and recommended certain measures. In addition the bonus scheme embracing both European and African employees has been revised by the industry so that part of the bonus has become consolidated within basic wages and a fixed rate (instead of variable rate) of bonus become payable based on the companies' profits on all metals produced and sold. Due to adequate supplies of Wankie coal costs of thermal power generated on the Copperbelt were lower.

Trade Notes

Brief descriptions of developments of interest to the mining engineer

Nylon for Conveyor Belting

Some notes on nylon-weft conveyor-belts which recently received N.C.B. approval in respect of the products of a number of well-known belting manufacturers have recently been circulated by **British Nylon Spinners, Ltd.,** of 25, Upper Brook Street, London, W. 1. This company points out that although nylon has been used extensively in solid-woven conveyor belting for some years past, and has proved outstandingly successful, particularly in the gruelling conditions underground, it can now be used in plied belting. At the moment interest is centred chiefly on its use as a weft yarn, but this



Craelius Pressure Grouting Pump.

does not, it is stated, preclude the possibilities of its introduction for the warp also. Several firms are in fact already actively investigating this aspect.

Much of the present interest in nylon for conveyor belting arises from the growing realization of the need to improve the weft strength. This was emphasized in a recent report by the N.C.B. which pointed out that belting seldom if ever " wears out " but is discarded because of accidental damage. It added : " It is apparent that the damage to the weft threads is a more important reason for the removal of belting than the damage to the warp threads " and concluded by making a strong recommendation for improvements in the lateral strength of belting.

The majority of belting manufacturers consider that the use of nylon offers the most attractive means of achieving this greater weft strength. The yarn has a tenacity of 8·8 g. per denier and is substantially stronger than any other textile yarn which can be used for the purpose. This yarn, 840 denier Type 600, was in fact developed by the company in 1956 specially for belting and tyre cords. Besides its tremendous strength it has a number of other properties which make it particularly suitable for belting. It has greater shock strength than any other fibre and greater abrasion resistance. It has very high flex strength and wet strength and it cannot rot. Preliminary investigations have shown that, broadly speaking, if the cotton weft of a conveyor-belt is replaced by a nylon weft of about one-third the weight it is possible to produce a stronger belt for very little increase in cost. There are numerous variations of this and different manufacturers are already using nylon in different ways.

Pressure Grouting Equipment

Equipment for pressure grouting is the subject of a new booklet just issued by the Svenska Diamantbergborrnings AB., of Stockholm. Included in this are particulars of a new pump, ZH-50, which is illustrated here, as well as details of the ancillary mixer and grout agitator. The mixer is suitable for giving a rapid and thorough mix of the grout in quantities suitable for feeding to the pump at its maximum capacity ; the agitator is suitable where larger quantities of grout have to be handled and is placed between the pump and the mixer. In this the grout is stirred by a slow-moving paddle, which prevents it from settling. The pump may be driven by an electric motor, as shown, or by an air motor, requiring 10 h.p. or 5 h.p. according to capacity and pressure. As an example of its use some details are also given of the Craelius drill-hole packer, which may be either a top packer or a deep-hole packer according to whether the hole is grouted in one run or in stages. The booklet can be obtained from the **Craelius Co., Ltd.,** of 11, Clarges Street, London, W. 1.

Isotope Developments Scintillation Counter.

Scintillation Counter

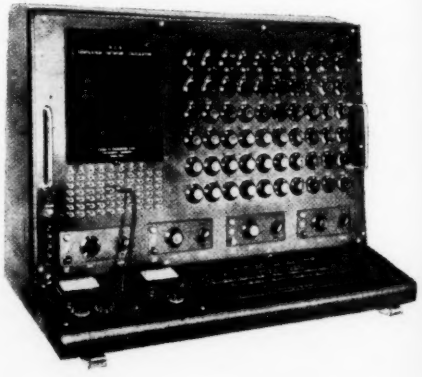
Among items shown at the Second U.N. International Atomic Energy conference and exhibition in Geneva (September 1 to 14) by **Isotope Developments, Ltd.,** of Benham Grange, Aldermaston Wharf, near Reading, was the scintillation counter illustrated here. The instrument, known as the type 1413A, is a high-sensitivity gamma detector designed for uranium prospecting, environmental surveys, and laboratory work and employs a sodium iodide detector and a transistor circuit for measurements in four ranges. When used in airborne or carborne work its output can be displayed on a 12-volt portable strip chart recorder. It has been developed and built to the design of the A.E.R.E. at Harwell and is operated by torch batteries such as are available throughout the world.

Fluid Network Analyser

Some particulars have been made available by **Nash and Thompson, Ltd.,** of Oakcroft Road, Chessington, Surrey, of their fluid network analyser. The instrument, illustrated here, has been designed to assist in the solution of non-linear network problems which are tedious to solve by ordinary methods of mathematical analysis. Such problems arise, for example, in studying the flow of air in mine ventilation and the instrument can be used in cases where the fluid flow conforms to the type to which the general law $P = CQ/_n$ applies, where P = pressure, Q rate of flow, C is a constant of fluid resistance, and n the index of flow. It was developed from a laboratory instrument devised at Nottingham University as a result of research sponsored by the N.C.B.

The principle on which it is based is the establishment of a network of linear electrical resistors identical in pattern to the system to be studied. This enables Kirchhoff's relationships to be continuously satisfied while the electrical resistancies are successively adjusted until the electrical currents flowing in the resistors correspond to the fluid flows in the system.

The currents and pressure drops around the



network are read on calibrated meters connected into circuit by means of jacks. The resistors on the instrument, which simulate branches of the system, are brought out to a connexion panel, where they may be connected into a number of junctions. Power packs stabilized against mains supply changes are provided to simulate sources of pressure—*e.g.*, fans and pumps. Where the system requires it, as for instance in gas and water distribution, a separate panel is used incorporating a number of units which simulate loads taking constant flows regardless of supply pressure. These can be connected into circuit in the same way as the resistors representing branches or sections of main.

The leaflet from which this is quoted goes on to explain that relatively junior staff can operate the instrument by following the instructions in the operating handbook and then gives an outline of the theoretical basis.

Personal

G. A. APOSTOLIDES is now manager of the Skoumsta chromite mine, Greece.

THOMAS VIVIAN BAINES has been appointed consulting geologist to the International Nickel Company in Africa.

W. J. DE VILLIERS has been appointed manager of the Rhokana Corporation.

R. A. H. FLUGGE-DE SMIDT has retired as group ventilation officer to the Union Corporation, Ltd.

WILLIAM M. FRAMES, of Johannesburg, formerly chairman of Rand Mines, Ltd., has been named chairman of the International Nickel Company S.A. (Proprietary), Ltd., South African subsidiary of the International Nickel Co. of Canada.

G. HARVEY is returning to Ghana.

T. A. HENDERSON is returning to England from Northern Rhodesia.

Tom T. HEYWOOD has been appointed mine superintendent of Sematan Bauxite, Ltd., Sarawak.

M. C. HOLEY is home from British Guiana.

P. R. LAKE is home from Burma.

HERBERT P. LEE has been appointed general manager of the Aero Service Corp. (Western), photogrammetric engineers, Salt Lake City, Utah.

MICHAEL MELLISH has left for South Africa.

W. S. RAPSON has been appointed vice-president of the South African Council for Scientific and Industrial Research.

R. J. E. THOMAS has left for Gambia.

REGINALD PAWLE, who died on August 10, aged 88, was trained at the Royal School of Mines, which he left in 1891 to work for a period at the Halkyn mine, in North Wales. In 1893, however, Mr. Pawle began his association with the Far East when he went to Sarawak for the Borneo Co., Ltd. From Borneo he began inspections in Malaya for the same company and in 1909 he became general superintendent at Pahang Consolidated, resigning in 1912, however, to take up consulting work as a partner in Pawle and Brelick. This association ceased in 1936 with the death of Mr. Henry Brelick, since when Mr. Pawle had lived in retirement. A Member of the Institution of Mining and Metallurgy, Mr. Pawle was a Member of Council from 1917 to 1924. He was also a one-time Member of Council of the Malayan Chamber of Mines and of the Tin Producers' Association.

INSTITUTION OF MINING AND METALLURGY

Elections and Transfers

Member.—John Perry DEMPSEY (*Dallas, Texas*); Denis Fletcher KELSALL, M.A. (*Kitwe*); Robert Franklyn PLAYTER, A.B. (*New York*); Peter Amyas YOUNG, B.A. (*Brough*); Robert Stansfield YOUNG, M.Sc., Ph.D. (*Victoria, B.C.*).

Associate Member to Member.—John Seymour BENSON, M.A. (*Akwatia, Ghana*); James Graham BOWER, Ph.D. (*Bramshill*); John Robinson BROWN, A.R.S.M. (*Barakin Ladi*); Joseph CHYNOWETH, A.C.S.M. (*Nicosia*); Grosvenor Rex DAVIS, Ph.D. (*Bulawayo*); Thomas Michael DOVER, A.C.S.M. (*Grantham*); Frank Fletcher ESPIE, B.E. (*Broken Hill, N.S.W.*); Allan John STRATFORD, A.C.S.M. (*Gwelo*); Noel Rudland STRATHON, A.C.S.M. (*Salisbury, S. Rhodesia*).

Associate Member.—Herbert George BURKS (*Dodoma*); Iorweth Gwyn HUGHES, B.Sc. (*Salt Pond, Ghana*); Joseph MITCHELL, B.Sc. (*Salt Pond*); Nirad Kumar SARKAR, A.C.S.M. (*Hutti, Mysore*); Desmond John TAYLOR (*Jos*); Robert SIBSON (*Birmingham*); Kenneth Allison TOWNLEY, B.Sc., A.R.S.M. (*Canberra*); Mousseau TREMBLAY, M.Sc., Ph.D. (*Mwadui*).

Associate Member.—Peter BEAUMONT (*Ouray*); Denzel Francois BRADSHAW, A.C.S.M. (*Kitwe*); Thomas Andrew HENDERSON, Ph.D. (*Kitwe*); Joseph Keith HUNTER, A.C.S.M. (*Kitwe*); John Edward Allan MACDONALD (*Buchans*); David Robert Troughton MYTTON, A.C.S.M. (*Kitwe*); William John TONKIN (*Pioneer Mine, B.C.*); Jack Desmond SANDY, A.R.S.M., B.Sc. (*Luanshya*); William Godson YUILL, B.Sc. (*Pinner*).

Affiliate.—Alfred Felix CHALMERS (*Gwanda*); Robert Wade MCCALLUM (*Pastro, Colombia*); Derek Anthony WILLIAMS (*Jos*).

Student.—Andrew Paterson BRUCE (*Henley*); James Graeme Dalrymple CRONE (*Canterbury, Aust.*); Robert Graham HANCOCK (*Camelford*); Chan Seng HON (*Kuala Lumpur*); Michael Lewis HOUSTON (*Brighton, Vic.*); Robin LEDSTONE (*Beckenham*); Brian Joseph MAHER (*Melbourne*); Gert Egon Johannis Hermann PRALLE (*Melbourne*); Ian Richard THOMPSON (*Melbourne*); David John VANCE (*Brisbane*); Charles Albert Peter WHITCUTT (*Obuasi*); Petros G. ZAMBAS, M.Sc. (*Nicosia*).

Metal Markets

During August[1]

Copper.—Now that political events play such an important part in the copper market it can no longer be assumed that interests will follow the seasonal trends of trade generally. The past month has been a particularly good example of this: Actual consumer buying has been no better than might be expected in Europe's peak holiday month, but developments affecting the market, and prices,[2] have been constantly changing. The two fundamental moves which have given rise to the majority of the excitement have been the U.S. Government's proposal to stockpile up to 150,000 tons of copper and the relaxation in embargoes on East–West trade. The first consideration kept the market on its toes for much of the month, as passage of the stockpiling proposals, which were an integral part of the Minerals Stabilisation Bill, became a race against time before Congress went into recess until next January. In the event, time was taken to consider the Bill and it was, surprisingly, rejected by a clear majority. The market was, naturally enough, quite depressed on this news, especially in view of another development at the time, which many people believed to be connected with it; this was the issuing by the Kennecott Copper Corporation of two announcements in quick succession about the expansion of the output rate at its Western Mines division. Although Kennecott's American mines are still operating at about 10% less than their 1957 level the increase in the operating rate compared with the fully cut-back rate is quite marked; it was attributed to the improved market position, especially in Europe. Paradoxically, however, Europe is still short of wirebars and premiums are still paid for these shapes.

On the whole, the implications of the easier trade between East and West, which particularly affect copper in all forms, have been taken as bullish. At the same time, when it was officially confirmed that restrictions on copper trade with Russia were to be eased, there were several people who asked whether Russian buying of raw copper might not develop only at the expense of the U.K.'s trade in wire with Russia. So far Russia has hardly bought enough raw copper to test this remark one way or the other.

In Northern Rhodesia there has been further tension between the unions and the mines over job classifications and the changes which the mines want to make in the interests of greater efficiency.

U.K. copper consumption in June was 57,418 tons, of which 46,080 tons was refined. Total consumption in the first half of the year was only some 11,000 tons down on the same period last year, which is a lot less tragic than some market reports would have suggested. Production in June was 6,620 tons primary refined and 8,812 tons secondary refined. There was a big drop in refined copper stocks to 59,558 tons, but stocks of blister were slightly up at 22,293 tons.

Tin.—For the greater part of August tin prices[2] struggled along in an apathetic holiday atmosphere, in which nobody could arouse any enthusiasm for the metal, despite the fact that all statistical forecasts continued to point to the idea that world consumption in 1958 would amount to more than Free World output *plus* Eastern exports. Matters were rudely shaken up late on August 29, however, when the Board of Trade announced that imports of tin into the U.K. from Eastern sources would no longer be possible on an Open General Licence basis. Apart from the restriction of licensing it was additionally announced that Russian tin would be subject to a quota over the three months from the date of the announcement of 750 tons, less than half the rate of exports to the U.K. in the first half of this year. This move is receiving supporting action in the Netherlands and Denmark and other consuming countries of the International Tin Agreement. It remains to be seen, of course, how far Russia steps up her sales to "outside" countries—such as, Germany and Japan—but in the first flush of enthusiasm the market jumped almost £15 per ton.

Consumption of tin in the U.K. in June was 1,719 tons and production was 2,964 tons.

Lead.—As was noted under copper the U.S. Government's Minerals Stabilization Bill, after a series of exasperating delays, was finally presented to the House of Representatives in the closing days, if not hours, of the past session and defeated. This means that after almost a year of negotiating the U.S. lead-zinc industry has neither the degree of tariff protection which it sought nor the subsidy which the Administration was hoping to persuade it to accept in lieu of this. The market, therefore, after brightening up on the idea that U.S. lead output would not, after all, be artificially stimulated to a higher level than at present (all of which would have to be sold) has subsequently turned rather duller,[1] in proportion as the U.S. mines' thoughts have turned back to pressing for higher tariff protection.

Lead, however, continues to benefit from a fundamentally less depressed statistical position than the other major metals. Nevertheless, consumption in the U.K. in the first half of 1958 at 170,868 tons was over 6,000 tons less than in the corresponding period of 1957 (June, 28,624 tons). Production in June was 6,859 tons and stocks increased during the month to a total of 40,518 tons.

Zinc.—The considerations affecting lead on the American political scene have also affected zinc similarly in August.[1] The latest turn of events is that the recent change in the Reciprocal Trade Act makes it possible, or so the Tariff Commission calculates, for the Commission to recommend, and the President to authorize, quite startling changes in lead and zinc tariffs, up to about 10 cents per lb. for lead and 7½ cents for zinc. The market's anxiety about possible tariff pleading is therefore understandable!

U.K. June zinc consumption was 25,587 tons and the half-year 154,141 tons. June output was 6,968 tons and stocks almost unchanged.

Iron and Steel.—The steel trade continues in the doldrums and sheet steel is the only main rolled product which is still in good demand. For other items demand is falling off as consumers meet their somewhat reduced requirements largely from stock. Following the Government measures aimed at easier economic conditions the banks have moved

[1] Recent prices, pp. 136, 176.
[2] See Table, p. 176.

[1] See Table, p. 176.

to stimulate consumer goods buying, but it will be some time before these measures can be translated into better order books at the steel mills.

Export demand is causing some anxiety; in the first seven months of this year U.K. exports of iron and steel fell by over 300,000 tons. The export of mild-steel plates has been freed for all destinations as the supply position has improved here, but world demand for plates in the past few months has declined sadly.

Apart from sheet steel there is little need to import iron and steel now, but arrivals of pig iron, ferro-alloys, and semis continue under outstanding contracts. Import duties on a number of products will be restored in the middle of September—suspension of duty will then apply only to certain cold-reduced sheets and hot-rolled strip and some high-carbon wire rods.

The general outlook for steel is not too happy. Short-time working and redundancy continue to be in evidence and no real improvement in the situation is expected for a month or two.

Iron Ore.—Iron ore imports are beginning to fall off a little; in the first seven months of this year they totalled 8,239,640 tons, against 8,558,615 tons in January–July, 1957.

Aluminium.—Effective from August 1 the Aluminum Co. of America raised its aluminium pig price 0·7 cents per lb. to 24·7 cents a lb., a price which soon became general in the U.S.A. Almost immediately Aluminium, Ltd., followed the U.S. increase and brought its price in the U.S.A. into line with that of U.S. sellers. To date there have been no indications of similar increases by Limited elsewhere, thereby breaking with the company's normal tradition of altering prices only on a world-wide basis. It is fairly obvious that the 0·7 cent increase by the U.S. concerns is a compromise between what the automatic wage increases, which became effective on August 1, are costing the companies and taking no action on price at all.

The open market in the United Kingdom brightened up a little during August and business was concluded at around £170 per ton delivered. No further news has been heard about the anti-dumping duty on aluminium which was applied for some seven months ago to stem the flood of Russian aluminium which was coming into the country; this flow seems to have slowed down somewhat of late, although it is almost certain that it will once more become an open-market factor.

The U.S. domestic aluminium industry is pressing for measures to curb imports of aluminium into the U.S.A. in the light of offerings by Communist bloc countries. Domestic industry spokesmen have had discussions with U.S. Government officials on a programme which would include international agreements to guide surplus aluminium to less-developed areas of the world instead of to the U.S.A.

The price of ingots in the United Kingdom still remains at £180 per ton delivered.

Antimony.—August was a very quiet month for the antimony market, with buyers not appearing too interested and supplies still fairly readily available. There have been no signs of any downward adjustment in prices of Russian and Chinese regulus during the month, although, as has been mentioned previously, English material, with its advantage of quicker delivery, quite competitive with regulus from Russia and China, it seems that in order to gain the edge on English metal prices must come down.

English regulus is quoted at £197 10*s*. per ton delivered.

Arsenic.—There have been no movements in this market during the past four weeks, in fact so far this year nothing has disturbed sales to any marked degree. Imports of arsenic trioxide during July totalled 2,180 tons; the price is quoted at £40 to £45 a ton.

Bismuth.—Nothing of real interest occurred in the bismuth market during August, although imports into this country during July were sharply up from the previous month. July imports totalled 115,434 lb. as compared with only 33,292 lb. The price in this country is still quoted at 16s. per lb.

Cobalt.—Imports of cobalt into the U.K. during July totalled 117,971 lb., a startling recovery from the 6,799 lb. imported during June. This brings the total U.K. imports for January–July, 1958, to 839,810 lb., as compared with 1,606,758 lb in the same period of last year.

The overall position in this country remains virtually unaltered from that obtaining for the past few months; cobalt metal is still quoted at 16s. per lb.

Cadmium.—As with many other metal markets cadmium has been uneventful during the past four weeks and it does not seem likely that any new factors will make an appearance in the near future. The price of cadmium in the U.K. is quoted at 10s. per lb.

Chromium.—Chromium metal does not alter very much from month to month and August proved to be no exception to the rule. The price continues to be quoted at 6s. 11d. to 7s. 4d. per lb.

Tantalum.—Following the price reduction in July the tantalum market has not moved very much during the past month. The majority of buyers seem to be quite well covered as regards their requirements and actual business is not very brisk at present. Imports of concentrates into the U.K. in July totalled 29 tons, in keeping with previous months. Total 1958 imports to date are 251 tons. The price is quoted at 900s.–950s. per unit.

Platinum.—U.K. and Empire refined material remained at £23 5s. per troy oz. during August, although the open-market price weakened and fell to £19 to £20 per oz. Business in open-market material is negligible with buyers seemingly just not interested in metal at any price.

In the U.S.A. leading refiners continue to quote $62 to $65 per troy oz., while open-market sellers are said to be offering at as low as $56 per oz.

Iridium.—The price of this metal eases slightly during August and is now quoted at £20 to £22 per troy oz., as compared with £20 to £23 previously. The market remained quiet with no signs of any alteration in the overall situation.

Osmium.—Consumer demand for osmium has not shown any improvement in the past four weeks and the price has suffered another fall and is now quoted nominally at £17 per troy oz.

Palladium.—As has been the case with its fellow members of the platinum group palladium during August has been quiet and uninteresting. There are no signs of any alteration in this situation in the near future and palladium continues to be quoted at £5 to £5 15s. nominal per troy oz.

Imports of platinum-group metals into the U.K. during July totalled 12,021 troy oz.

Tellurium.—As has been the case for months past this market has been quiet and featureless

during August. The price is still quoted in the U.K. at 15s. to 16s. per lb.

Tungsten.—During August the tungsten market was extremely quiet with only the smallest amount of business passing. There is a faint hope that now the subsidizing of U.S. mines has been turned down, there may be a little more U.S. buying from overseas sources. However, at present there are no real signs of any such development.

The current price of tungsten ore is 60s. to 65s. per long ton unit of WO_3.

Nickel.—August was a fairly quiet month for nickel and the broad outlook for this metal has not changed very much. The International Nickel Co. is still having labour trouble as its talks with the Mine-Mill Union on a new wage agreement have broken down. Apparently talks have been going on since April and the old contract ran out on June 1. Western Nickel, Ltd., Canada's newest producer, suspended operations due to contract cancellations. The resumption of operations will depend on finding other markets for its nickel concentrates.

The price of nickel in the U.K. remains at £600 a ton.

Chromium.—Following the price reductions at the end of July the chrome-ore market has been quiet with no outstanding features apparent. Stocks still seem to be fairly high despite the price reduction which, it was hoped, might awaken a little more buying interest.

Rhodesian metallurgical grade ore 48% continues to be quoted at £15 15s. a ton.

Molybdenum.—Following the news of the strike at Climax, Colorado, in the latter part of July nothing new has emerged in this market during August. Supplies do not appear to have been affected, for, as was mentioned in the previous report, the company has substantial stocks of material in hand.

Molybdenite in the U.K. is quoted at 8s. 5d. per lb. of metal contained f.o.b.

Manganese.—There was no improvement to report in this market during August, with the situation in India showing no signs of becoming easier. It had been suggested that August was the month when the manganese-ore market would start to look up but as yet there are no signs of this. In addition to the increased royalty which Indian mine owners have now to pay to the central Government there are rumours that some states are thinking of levying a cess on manganese-ore sales to help finance social security schemes for mine-workers.

Manganese ore (46 to 48% Mn) c.i.f. Europe is now quoted nominally at 84d. to 88d. per unit of metal contained.

Tin, Copper, Lead, and Zinc Markets

Tin, minimum, 99·75%; Copper, electro; Lead, minimum 99·75%; and Zinc, minimum 98%, per ton.

Date	Tin		Copper		Lead		Zinc	
	Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Aug. 12	730 10	732 15	206 7½	206 17½	70 17½	72 7½	64 3¾	64 16¼
13	730 10	731 5	205 10	206 2½	70 2½	72 2½	63 15	64 13¾
14	730 10	730 5	206 12½	206 17½	69 7½	71 2½	63 12½	64 11¼
15	730 10	730 5	207 15	207 17½	69 17½	71 7½	63 17½	64 12½
18	730 10	726 15	208 2½	208 2½	69 15	71 2½	63 7½	64 7½
19	730 10	728 15	206 7½	206 7½	69 16¼	71 3¾	62 18¾	63 17½
20	730 10	730 5	206 17½	207 2½	69 2½	70 13¾	62 12½	63 7½
21	730 10	730 10	207 12½	207 12½	67 18¾	69 13¾	62 2½	63 0
22	730 10	730 5	200 2½	200 5	69 2½	70 17½	63 10	64 2½
25	730 10	730 15	204 2½	204 2½	70 6¼	71 16¼	64 2½	64 17½
26	730 10	730 15	203 10	203 17½	69 7½	71 3¾	63 15	64 7½
27	730 10	730 15	203 7½	203 12½	69 2½	70 18¾	63 7½	64 3¾
28	731 0	730 15	201 5	201 7½	69 12½	71 6¼	63 12½	64 8¾
29	731 10	731 15	202 5	202 7½	69 17½	71 16¼	63 17½	64 15
Sept. 1	746 0	745 10	203 5	203 12½	70 17½	72 7½	64 16¼	65 6¼
2	740 10	739 15	205 5	205 7½	70 17½	72 6¼	64 15	65 6¼
3	734 0	733 10	206 5	206 7½	71 7½	72 7½	64 12½	65 2½
4	730 10	731 5	206 7½	206 12½	71 18¾	72 18¾	64 12½	65 2½
5	730 10	726 15	206 10	206 15	71 3¾	72 3¾	63 17½	64 11¼
8	730 10	726 15	206 7½	206 12½	71 0	72 3¾	64 8¾	64 17½
9	730 10	726 0	206 17½	206 17½	70 17½	72 3¾	64 17½	65 3¾
10	730 10	727 15	207 2½	207 2½	70 17½	72 2½	65 0	65 8¼

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	July		August	
	Treated Tons.	Yield Oz.†	Treated Tons.	Yield Oz.*
Blyvooruitzicht	106,000	66,967	105,000	67,858
Brakpan	129,000	16,504	125,000	16,563
Buffelsfontein‡	117,000	39,172	118,000	39,884
City Deep	115,000	23,865	117,000	24,049
Cons. Main Reef	136,000	21,087	129,000	20,792
Crown Mines	240,000	36,145	237,000	35,353
Daggafontein	242,000	49,726	242,000	49,730
Doornfontein‡	88,000	36,753	86,000	36,163
D'rb'n Roodeport Deep	188,000	34,033	189,000	34,120
East Champ D'Or‡	13,500	292	13,100	354
East Daggafontein	94,000	15,493	94,000	15,486
East Geduld	136,000	41,818	131,000	40,284
East Rand P.M.	242,000	59,357	231,000	57,326
Eastern Transvaal Consol	18,600	6,408	18,200	6,381
Ellaton‡	32,000	7,460	32,000	7,470
Freddies Consol.	58,000	14,603	58,000	14,933
Free State Geduld	70,000	50,200	72,000	51,781
Geduld	78,000	13,071	75,000	12,942
Government G.M. Areas‡	63,000	11,430	62,000	11,501
Grootvlei Proprietary	205,000	43,577	200,000	42,527
Harmony Gold Mining	85,000	32,716	92,000	36,811
Hartebeestfontein‡	87,000	47,415	87,000	47,415
Libanon	98,000	22,831	98,000	23,123
Loraine	75,000	14,182	74,000	14,622
Luipaards Vlei‡	121,000	13,769	120,000	13,566
Marievale Consolidated	74,000	19,347	72,000	18,901
Merriespruit‡	—	—	—	—
Modderfontein East	146,000	13,761	136,000	13,373
New Kleinfontein	87,000	10,354	83,000	10,939
New Klerksdorp‡	10,500	1,088	9,900	1,067
President Brand	96,000	70,779	98,000	72,173
President Steyn	100,000	37,831	98,000	37,510
Rand Leases	174,000	25,578	180,000	26,370
Randfontein‡	207,000	14,903	199,000	14,154
Rietfontein Consolid't'd.	21,500	4,902	21,000	4,808
Robinson Deep	72,000	15,851	77,000	16,016
Rose Deep	60,000	7,176	53,000	6,732
St. Helena Gold Mines	124,000	36,311	124,000	36,321
Simmer and Jack	90,000	16,853	90,000	16,950
S. African Land and Ex.	91,500	18,853	91,500	18,853
S. Roodepoort M.R.	31,000	7,322	29,000	6,905
Spaarwater Gold	10,700	3,298	10,700	3,298
Springs	129,000	14,661	130,000	15,150
Stilfontein Gold Mining‡	117,000	57,310	122,000	59,597
Sub Nigel	66,500	15,993	66,500	16,116
Transvaal G.M. Estates	13,500	1,950	12,300	1,794
Vaal Reefs‡	76,000	34,507	77,000	35,036
Van Dyk Consolidated	80,000	14,997	78,000	14,256
Venterspost Gold	128,000	31,821	133,000	32,892
Village Main Reef	28,000	4,693	28,500	4,823
Virginia O.F.S.‡	105,000	27,195	108,000	28,350
Vlakfontein	50,000	17,633	50,000	17,674
Vogelstruisbult‡	95,000	21,333	95,000	21,114
Welkom Gold Mining	91,500	27,082	91,500	27,111
West Driefontein‡	80,000	76,010	80,000	76,626
West Rand Consol. ‡	210,000	21,612	207,000	21,142
Western Holdings	100,000	56,004	100,000	56,359
Western Reefs	114,500	26,794	111,500	27,120
Witwatersrand Nigel	18,200	4,423	18,200	4,355

† 248s. 4d. * 249s. 6d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION

	Tons milled	Yield per ton	Work'g cost per ton	Work'g profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
June* 1957.	16,785,200	62 4	45 1	17 3	22,595,371
July	—	—	—	—	—
August	—	—	—	—	—
Sept.*	16,699,900	64 0	45 6	17 3	24,193,575
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	16,198,500	64 4	46 1	18 3	23,695,380
Jan., 1958	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.	15,806,300	64 10	46 6	18 4	23,170,987
April	—	—	—	—	—
May	—	—	—	—	—
June	16,435,500	64 9	46 6	18 3	24,358,945

* 3 Months.

PRODUCTION OF GOLD IN SOUTH AFRICA

	Rand and O.F.S.	Outside	Total
	Oz.	Oz.	Oz.
August, 1957	1,426,340	38,941	1,459,794
September	1,400,745	37,611	1,438,356
October	1,416,211	39,996	1,456,207
November	1,386,047	36,470	1,422,517
December	1,366,354	35,789	1,402,143
January, 1958	1,377,505	40,534	1,418,039
February	1,322,843	33,879	1,356,722
March	1,394,956	36,330	1,431,286
April	1,401,094	38,352	1,439,446
May	1,435,960	36,494	1,472,454
June	1,408,384	39,187	1,447,571
July	1,456,925	42,312	1,499,237

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	Gold Mines	Coal Mines	Total
November 30, 1957	305,104	27,619	332,723
December 31	299,137	27,623	326,760
January 31, 1958	314,239	28,489	342,728
February 28	326,885	30,227	357,112
March, 31	333,862	31,203	365,065
April, 30	337,284	31,424	368,708
May 31	337,464	31,509	368,973
June 30	334,882	31,336	366,218
July 31	336,356	31,608	367,964

MISCELLANEOUS METAL OUTPUTS

	4-Week Period To July 26		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	32,560	5,764	7,529
Electrolytic Zinc	16,896	809	5,092
Lake George	18,365	1,541	3,007
Mount Isa Mines**	78,558	4,300†	2,458
New Broken Hill	43,150	6,800	9,940
North Broken Hill	37,850	7,521	7,478
Zinc Corp.	59,880	9,279	10,213
Rhodesia Broken Hill*	—	—	—

* 3 Mths. ** Copper 2,765 tons. † Metal.

RHODESIAN GOLD OUTPUTS

	July		August	
	Tons	Oz.	Tons	Oz.
Cam and Motor	30,907	9,642	32,294	9,983
Falcon Mines	22,610	4,346	21,800	4,438
Globe and Phœnix	6,300	3,575	6,300	3,540
Motapa Gold Mining	16,100	1,809	17,900	1,839
Mazoe	2,844	851	3,170	902
Coronation Syndicate	11,263	4,117	11,536	4,232
Phoenix Prince*	—	—	—	—

* 3 Months

WEST AFRICAN GOLD OUTPUTS

	July		August	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	60,171	14,285	64,423	15,134
Ariston Gold Mines	37,000	12,313	37,150	12,474
Ashanti Goldfields	31,250	24,750	31,250	24,750
Bibiani	35,000	6,900	33,500	6,900
Bremang	—	4,462	—	5,299
Ghana Main Reef	11,194	4,098	11,380	4,241
Konongo	6,100	3,801	6,180	3,924
Lyndhurst	—	—	—	—

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1957		1958	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	44,337	6,134	44,305	46,553
February	41,607	5,697	43,591	21,313
March	43,831	8,179	43,830	8,179
April	46,754	6,854	46,587	22,573
May	42,650	5,606	46,015	19,937
June	46,682	6,441	46,453	20,105
July	41,922	5,781	44,244	19,170
August	44,001	5,897	—	—
September	45,762	5,677	—	—
October	46,838	5,570	—	—
November	46,987	6,331	—	—
December	45,479	5,814	—	—

WESTRALIAN GOLD PRODUCTION

	1956	1957	1958
	Oz.	Oz.	Oz.
January	66,388	106,722	66,562
February	94,638	64,949	65,965
March	66,944	67,121	65,420
April	60,415	66,435	60,855
May	62,294	64,886	64,196
June	63,570	65,142	—
July	69,883	74,420	81,106
August	72,303	75,727	—
September	62,204	64,422	—
October	64,594	64,524	—
November	64,113	65,700	—
December	65,031	66,562	—
Total	812,377	846,610	

AUSTRALIAN GOLD OUTPUTS

	4-Week Period			
	To July 8		To Aug. 5	
	Tons	Oz.	Tons	Oz.
Central Norseman	14,002	8,363	14,260	9,171
Crœsus Proprietary	—	—	—	—
Gold Mines of Kalgoorlie	41,487	10,375	40,204	10,922
Golden Horse Shoe*	—	—	118,839	29,673
Gt. Boulder Gold Mines*	—	—	—	—
Gt. Western Consolidated	41,470	6,767	37,875	5,588
Hill 50	—	—	—	—
Kalgurli Ore Treatment	—	—	—	—
Lake View and Star*	—	—	—	—
Moonlight Wiluna*	—	—	—	—
Morning Star (G.M.A.)	1,573	981	1,606	1,280
Mount Ida*	—	—	—	—
New Coolgardie	—	—	—	—
North Kalgurli	26,746	6,626	—	—
Sons of Gwalia	12,012	2,439	1,3446	2,558
Mount Morgan	—	4,299	—	4,677

* 3 Months.

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n $
March, 1957	793,674	215,830	35,787	7,250,018
April	771,608	216,457	35,685	7,314,450
May	790,159	222,436	37,241	7,509,638
June	738,384	207,897	32,544	6,945,127
July	718,468	198,620	30,620	6,572,323
August	701.174	192,453	31,647	6,410,429
September	722,384	205,471	34,248	6,947,813
October	772,383	224,217	37,086	7,657,426
November	756,494	219,352	37,737	7,441,702
December	750,537	215,462	44,230	7,494,289
January, 1958	779,128	219,502	31,562	7,462,598
February	727,170	210,646	35,370	7,248,333
March	807,458	229,361	38,323	7,873,264
April	785,264	228,590	35,712	7,789,644
May	801,102	228,123	37,535	7,745,425
June	775,384	228,960	42,275	7,740,144

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	July		Aug.	
	Tons	Oz.	Tons	Oz.
British Guiana Cons.	—	1,011	—	—
Central Victoria Dredging	—	—	—	—
Clutha River	—	354	—	474
Emperor Mines (Fiji)*	—	—	—	—
Frontino Gold (Colombia)	—	—	—	—
Geita Gold (Tanganyika)	—	—	—	—
Harrietville (Aust.)	—	—	—	—
Lampa (Peru)†	—	31,820	—	—
Loloma (Fiji)*	—	—	—	—
New Guinea Goldfields	4,305	1,214	—	—
St. John d'el Rey (Brazil)	—	—	—	—
Yukon Consol.	—	$305,000	—	$354,000

* 3 Months. † Ozs. Silver: 61 tons copper, 50 tons.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	June	July	Aug.
Ampat Tin	—	79	—
Austral Amalgamated	—	—	—
Ayer Hitam	141*	—	—
Batu Selangor	—	—	—
Berjuntai	—	120	—
Chenderiang	20*	—	—
Gopeng Consolidated	109*	—	—
Hongkong Tin	49*	—	—
Idris Hydraulic	36*	—	—
Ipoh	48½*	—	—
Jelapang Tin	—	—	—
Kampong Lanjut	—	67	—
Kamunting	—	127	—
Kent (F.M.S.)	37*	—	—
Kepong	43*	—	—
Killinghall	53*	—	—
Kinta Kellas	—	35	—
Kinta Tin Mines	54½*	—	—
Klang River	—	—	—
Kramat	—	56	—
Kuala Kampar	—	113½	—
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Lahat Mines	—	—	—
Larut	—	—	—
Lower Perak	—	125½	—
Malayan	286*	—	—
Malaysiam	—	6	6½
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	415*	—	—
Pengkalen	53*	—	—
Petaling Tin	138*	—	—
Puket	89*	—	—
Rahman Hydraulic	—	—	—
Rambutan	23½*	—	—
Rantau	—	31	—
Rawang Concessions	—	—	—
Rawang Tin Fields	—	—	—
Renong	116*	—	—
Selayang	46*	—	—
Siamese Tin Syndicate (Malaya)	8	31½	—
Southern Kinta	—	275½	—
Southern Malayan	454*	—	—
Southern Tronoh	103*	—	—
Sungei Besi	117½*	—	—
Sungei Kinta	38*	—	—
Sungei Way	194½*	—	—
Taiping Consolidated	—	44	—
Tambah	—	—	—
Tanjong	119*	—	—
Tekka	18*	—	—
Tekka-Taiping	—	—	—
Temoh	13*	—	—
Tongkah Compound	—	—	—
Tongkah Harbour	—	34	—
Tronoh	335*	—	—
Ulu Klang	—	—	—

* 3 months.

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	July		August	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines ..	213	22	—	—
Anglo-Burma Tin	20	—	33	—
Bangrin	72	—	—	—
Beralt	65	95†	68	103†
Bisichi	40½	6	68	11
Ex-Lands Nigeria	51	—	52	—
Geevor	64	—	35	—
Gold and Base Metal	37	1	41	1
Jantar Nigeria	13	12½	16½	17
Jos Tin	12½	—	—	—
Kaduna Prospectors	5	—	6	—
Kaduna Syndicate	14½	—	18	—
Katu Tin	72	—	—	—
Kefri Tin	—	—	—	—
London Nigerian Mines ...	—	—	—	—
Mawchi Mines	—	—	—	—
Naraguta Extended	16½	—	—	—
Naraguta Karama	10½	—	—	—
Naraguta Tin	—	—	—	—
Renong Consolidated	—	—	—	—
Ribon Valley (Nigeria)	8½	—	10½	—
Siamese Tin Syndicate	33	—	—	—
South Bukeru	—	—	—	—
South Crofty	71	—	36½	—
Tavoy Tin	10	—	—	—
Tin Fields of Nigeria	—	—	—	—
United Tin Areas of Nigeria	3½	—	5½	—

† Wolfram.

SOUTH AFRICAN MINERAL OUTPUT
June, 1958

Gold	1,444,774 oz.
Silver	154,400 oz.
Diamonds	209,710 carats.*
Coal	3,261,669 tons.
Copper	(*a*) 91 tons in matte and copper-gold concentrates. (*b*) 4,042 tons of 99·41%.
Tin	121 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	15,274 tons.
Chrome Ore	49,308 tons.
Manganese Ore	70,673 tons.
Lead Concs.	— tons.

* May., 1958.

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

		June	July
Iron Ore	tons	1,364,375	1,184,419
Manganese Ore	,,	8,883	30,251
Iron and Steel	,,	86,694	61,069
Iron Pyrites	,,	10,156	29,461
Copper Metal	,,	28,971	45,003
Tin Ore	,,	3,537	3,998
Tin Metal	,,	1,029	329
Lead	,,	18,115	10,189
Zinc Ore and Conc.	,,	9,688	8,748
Zinc	,,	12,174	10,932
Tungsten Ores	,,	309	409
Chrome Ore	,,	8,336	23,436
Bauxite	,,	32,800	17,250
Antimony Ore and Concs.	,,	207	1,710
Titanium Ore	,,	17,244	20,366
Nickel Ore	,,	5,867	4,031
Tantalite/Columbite	,,	17	29
Sulphur	,,	21,692	37,599
Barytes	,,	3,025	5,971
Asbestos	,,	11,424	11,273
Magnesite	,,	2,296	3,649
Mica	,,	398	448
Graphite	,,	127	550
Mineral Phosphates	,,	55,002	77,471
Molybdenum Ore	,,	287	393
Nickel	cwt.	18,853	50,685
Aluminium	,,	382,588	269,516
Mercury	lb.	60,278	170,765
Bismuth	,,	33,292	115,434
Cadmium	,,	258,409	119,708
Cobalt and Cobalt Alloys	,,	6,799	117,971
Selenium	,,	30,226	7,571
Petroleum Motor Spirit ...	1,000 gals.	51,331	78,252
Crude	,,	683,691	772,199

Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	106	0	0
,, ,, 80% Technical	,,	97	0	0
Alum, Comml.	,,	25	0	0
Aluminium Sulphate	,,	16	10	0
Ammonia, Anhydrous	per lb.		2	0
Ammonium Carbonate	per ton	59	0	0
,, Chloride, 98%	,,	26	0	0
,, Phosphate (Mono- and Di-) ...	,,	102	0	0
Antimony Sulphide, golden	per lb.		3	0
Arsenic, White, 99/100%	per ton	47	10	0
Barium Carbonate (native), 94%	,,	Nominal		
,, Chloride	,,	53	0	0
Barytes (Bleached)	,,	20	0	0
Benzole	per gal.		5	2
Bleaching Powder, 36% Cl.	per ton	30	7	6
Borax	,,	44	0	0
Boric Acid, Comml.	,,	75	10	0
Calcium Carbide	,,	40	17	9
,, Chloride, solid, 70/75%	,,	13	5	0
Carbolic Acid, crude 60's	per gal.		8	3
Carbon Bisulphide	per ton	62	10	0
Chromic Acid (ton lots)	per lb.		2	2½
Citric Acid	per cwt.	11	0	0
Copper Sulphate	per ton	70	0	0
Creosote Oil (f.o.r. in Bulk)	per gal.		1	2
Cresylic Acid, 97–98%	,,		6	6
Hydrochloric Acid 28° Tw.	per carboy		13	0
Hydrofluoric Acid, 59/60%	per lb.		1	1
Iron Sulphate	per ton	3	17	6
Lead, Acetate, white	,,	124	0	0
,, Nitrate	,,	116	0	0
,, Oxide, Litharge	,,	106	5	0
,, Red	,,	104	5	0
,, White	,,	116	0	0
Lime, Acetate, brown	,,	40	0	0
Magnesite, Calcined	,,	20	0	0
,, Raw	,,	9	0	0
Magnesium Chloride, ex W'h'se	,,	16	0	0
,, Sulphate, Comml.	,,	15	10	0
Methylated Spirit, Industrial, 66 O.P.	per gal.		6	3
Nitric Acid, 80° Tw.	per ton	37	10	0
Oxalic Acid	,,	129	0	0
Phosphoric Acid (S.G. 1·750)	per lb.		1	4
Pine Oil	per ton	Nominal		
Potassium Bichromate	per lb.		1	2½
,, Carbonate (hydrated)	per ton	74	10	0
,, Chloride, 96%	,,	21	0	0
,, Iodide	per lb.		9	0
,, Amyl Xanthate	,,	Nominal		
,, Ethyl Xanthate	,,	Nominal		
,, Hydrate (Caustic) solid	per ton	118	0	0
,, Nitrate	per cwt.	4	1	0
,, Permanganate	per ton	193	10	0
,, Sulphate, 48%	,,	22	1	0
Sodium Acetate	,,	99	0	0
,, Arsenate, 58–60%	,,	Nominal		
,, Bicarbonate	,,	15	0	0
,, Bichromate	per lb.		1	0
,, Carbonate (crystals)	per ton	Nominal		
,, ,, (Soda Ash) 58%	,,	13	5	0
,, Chlorate	,,	92	0	0
,, Cyanide 100% NaCN basis	per cwt.	6	6	6
,, Hydrate, 76/77%, solid	per ton	33	0	0
,, Hyposulphite, Comml.	,,	32	15	0
,, Nitrate, Comml.	,,	29	10	0
,, Phosphate (Dibasic)	,,	40	10	0
,, Prussiate	per lb.		1	0½
,, Silicate	per ton	11	0	0
,, Sulphate (Glauber's Salt)	,,	9	15	0
,, ,, (Salt-Cake)	,,	8	0	0
,, Sulphide, flakes, 60/62%	,,	37	2	6
,, Sulphite, Comml.	,,	27	10	0
Sulphur, American, Rock (Truckload)	,,	16	0	0
,, Ground, Crude	,,	17	10	0
Sulphuric Acid, 168° Tw.	,,	10	10	0
,, ,, free from Arsenic, 140° Tw.	,,	8	0	0
Superphosphate of Lime, 18% P_2O_5	,,	14	18	6
Tin Oxide	,,	Nominal		
Titanium Oxide, Rutile	,,	172	0	0
,, White, 25%	,,	85	0	0
Zinc Chloride	,,	95	0	0
,, Dust, 95/97% (4-ton lots)	,,	104	0	0
,, Oxide	,,	88	10	0
,, Sulphate	,,	32	0	0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:	Aug. 8, 1958 £ s. d.	Sept. 9, 1958 £ s. d.
SOUTH AFRICA:		
Blinkpoort (5s.)	2 7 3	2 8 9
Blyvooruitzicht (2s. 6d.)	1 2 6	1 3 0
Brakpan (5s.)	4 6	5 0
Buffelsfontein (10s.)	1 19 3	2 2 3
City Deep	13 9	14 0
Consolidated Main Reef	14 9	16 0
Crown Mines (10s.)	1 3 0	1 5 3
Daggafontein (5s.)	1 10 3	1 9 9
Dominion Reefs (Ord. 5s.)	12 0	15 0
Doornfontein (10s.)	1 5 6	1 7 3
Durban Roodepoort Deep (10s.)	1 9 3	1 7 9
East Champ d'Or (2s. 6d.)	1 6	1 9
East Daggafontein (10s.)	8 3	8 6
East Geduld (4s.)	1 5 0	1 4 9
East Rand Proprietary (10s.)	1 18 9	1 18 9
Freddies Consol.	2 3	2 3
Free State Dev. (5s.)	5 6	5 3
Free State Geduld (5s.)	4 11 0	4 15 0
Free State Saaiplaas (10s.)	14 3	16 9
Geduld	3 2 9	3 3 0
Government Gold Mining Areas (5s.)	3 6	3 6
Grootvlei (5s.)	14 3	14 9
Harmony (5s.)	1 17 3	1 18 9
Hartebeestfontein (10s.)	3 3 0	3 7 3
Libanon (10s.)	7 6	8 0
Loraine (10s.)	2 6	2 6
Luipaards Vlei (2s.)	9 3	10 3
Marievale (10s.)	18 3	18 6
Merriespruit (5s.)	4 0	4 3
Modderfontein B (3d.)	2 9	2 9
Modderfontein East	13 6	14 0
New Kleinfontein	3 9	4 0
New Pioneer (5s.)	1 14 0	1 16 3
New State Areas (10s.)	2 0	1 6
President Brand (5s.)	2 16 0	2 19 0
President Steyn (5s.)	1 9 3	1 10 3
Rand Leases (10s.)	4 0	4 3
Randfontein	1 4 3	1 4 6
Riebeeck (10s.)	15 9	16 3
Rietfontein (4s.)	8 0	7 6
Robinson Deep (6s.)	10 3	10 9
Rose Deep (6s. 6d.)	10 0	10 3
St. Helena (10s.)	2 1 6	2 3 0
Simmer and Jack (2s.)	3 9	3 6
South African Land (3s. 6d.)	1 1 3	1 2 0
Springs (5s.)	1 9	1 9
Stilfontein (5s.)	2 0 6	2 4 9
Sub Nigel (10s.)	13 0	13 3
Vaal Reefs (5s.)	1 15 6	1 18 0
Van Dyk (7s. 9d.)	3 6	3 6
Venterspost (10s.)	14 3	15 0
Virginia (5s.)	7 9	7 9
Vlakfontein (10s.)	15 3	15 6
Vogelstruisbult (10s.)	7 9	8 9
Welkom (5s.)	14 9	17 9
West Driefontein (10s.)	5 1 3	5 3 9
West Rand Consolidated (10s.)	1 5 6	1 5 6
West Witwatersrand Areas (2s. 6d.)	2 5 9	2 6 6
Western Holdings (5s.)	4 19 0	5 4 0
Western Reefs (5s.)	1 8 0	1 10 9
Winkelhaak (10s.)	16 9	17 6
Witwatersrand Nigel (2s. 6d.)	1 3	1 3
RHODESIA:		
Cam and Motor (2s. 6d.)	8 0	8 0
Chicago-Gaika (10s.)	15 0	16 3
Coronation (2s. 6d.)	3 6	3 6
Falcon (5s.)	7 6	7 6
Globe and Phœnix (5s.)	1 8 0	1 10 0
Motapa (5s.)	6	6
GOLD COAST:		
Amalgamated Banket (3s.)	1 0	1 0
Ariston Gold (2s. 6d.)	4 0	4 3
Ashanti Goldfields (4s.)	15 9	15 3
Bibiani (4s.)	2 0	2 0
Bremang Gold Dredging (5s)	1 3	1 3
Ghana Main Reef (5s.)	1 9	1 6
Konongo (2s.)	1 7	1 6
Kwahu (2s.)	3 0	2 9
Taquah and Abosso (3s.)	—	—
Western Selection (5s.)	4 3	5 0
AUSTRALASIA:		
Gold Fields Aust. Dev. (3s.), W.A.	1 6	1 6
Gold Mines of Kalgoorlie (10s.)	8 9	8 6
Great Boulder Propriet'y (2s.), W.A.	12 9	12 3
Lake View and Star (4s.), W.A.	1 2 9	1 2 9
London-Australian (2s.)	—	—
Mount Morgan (10s.), Q.	10 6	9 3
New Guinea Gold (4s. 3d.)	1 6	1 6
North Kalgurli (1912) (2s.), W.A.	7 6	8 0
Sons of Gwalia (10s.), W.A.	2 3	2 3
Western Mining (5s.), W.A.	8 0	8 6

	Aug. 8, 1958 £ s. d.	Sept. 9, 1958 £ s. d.
MISCELLANEOUS:		
Fresnillo ($1·00)	2 2 9	2 1 0
Kentan Gold Areas (1s.), E. Africa	3	3
St. John d'el Rey, Brazil	2 15 0	2 14 3
Yukon Consolidated ($1)	4 9	4 6
COPPER:		
Bancroft Mines (5s.), N. Rhodesia	1 0 6	1 0 0
Esperanza (2s. 6d.), Cyprus	1 9	1 7
Indian (2s.)	4 6	4 6
MTD (Mangula) (5s.)	7 0	7 0
Messina (5s.), Transvaal	4 13 3	4 11 3
Mount Lyell, Tasmania	18 6	19 6
Nchanga Consolidated, N. Rhodesia	10 17 3	10 15 0
Rhokana Corporation, N. Rhodesia	27 0 0	26 10 0
Roan Antelope (5s.), N. Rhodesia	8 6	8 0
Tanganyika Concessions (10s.)	3 2 0	2 17 6
LEAD-ZINC:		
Broken Hill South (5s.), N.S.W.	2 4 6	2 3 9
Burma Mines (3s. 6d.)	1 9	1 9
Consol. Zinc Corp. Ord.	2 9 3	2 13 0
Electrolytic Zinc, Tasmania (Pref. 5s.)	2 12 6	2 12 6
Lake George (5s.), N.S.W.	4 6	4 3
Mount Isa, Queensland (5s. Aust.)	1 4 0	1 4 9
New Broken Hill (5s.), N.S.W.	1 12 6	1 12 9
North Broken Hill (5s.), N.S.W	3 15 0	3 10 6
Rhodesia Broken Hill (5s)	7 9	7 9
San Francisco (10s.), Mexico	17 6	18 6
TIN:		
Amalgamated Tin (5s.), Nigeria	5 0	5 9
Ampat (4s.), Malaya	6 0	6 3
Ayer Hitam (5s.), Malaya	1 2 6	1 4 0
Beralt (5s.), Portugal	1 5 0	1 2 6
Bisichi (2s. 6d.), Nigeria	2 9	2 9
Ex-Lands (2s.), Nigeria	1 9	1 9
Geevor (5s.), Cornwall	13 0	14 6
Gold Base Metals (2s. 6d.), Nigeria	9	9
Hongkong (5s.), Malaya	4 0	4 3
Jantar Nigeria (3s.)	2 0	2 0
Kaduna Syndicate (2s.), Nigeria	2 0	1 10
Kamunting (5s.), Malaya	8 3	8 6
Kramat Pulai (3d.), Malaya	3 0	4 3
Malayan Tin Dredging (5s.)	9 9	9 6
Mawchi Mines (4s.), Burma	1 6	1 3
Naraguta Extended (5s.), Nigeria	9	9
Pahang (5s.), Malaya	4 0	4 3
Siamese Synd. (5s.)	6 6	6 6
South Crofty (5s.), Cornwall	3 0	3 6
Southern Kinta (5s.), Malaya	15 9	16 6
Southern Malayan (5s.)	8 3	8 9
Southern Tronoh (5s.), Malaya	7 6	8 6
Sungei Besi (4s.), Malaya	13 9	13 6
Sungei Kinta, Malaya	12 6	12 6
Tronoh (5s.), Malaya	9 9	10 6
United Tin Areas (2s. 6d.), Nigeria	4½	6
DIAMONDS:		
Anglo American Investment	9 7 6	9 6 3
Consol African Selection Trust (5s.)	13 6	15 0
Consolidated of S.W.A. Pref (10s.)	11 0	11 3
De Beers Deferred (5s.)	5 5 0	5 9 0
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African & European (10s.)	3 6 3	3 8 6
Anglo American Corporation (10s.)	7 9 0	7 16 3
Anglo-French Exploration	1 3 0	1 3 0
Anglo Transvaal 'A' (5s.)	1 12 0	1 15 0
British South Africa (15s.)	3 7 0	3 8 0
British Tin Investment (10s.)	14 0	15 9
Broken Hill Proprietary	1 18 0	1 19 0
Camp Bird (10s.)	10 0	11 3
Central Mining	3 4 9	3 6 0
Central Provinces Manganese (10s.)	1 9 0	1 10 6
Consolidated Gold Fields	2 14 0	2 15 0
Consolidated Mines Selection (10s.)	1 14 3	1 16 0
East Rand Consolidated (5s.)	1 3	1 3
Free State Development (5s.)	5 6	5 3
General Exploration O.F.S. (2s. 6d.)	4 3	4 6
General Mining and Finance	4 16 0	4 17 0
H.E. Proprietary (5s.)	8 6	11 0
Johannesburg Consolidated	2 6 0	2 6 6
London & Rhod. M. & L. (5s.)	7 6	7 9
London Tin Corporation (4s.)	7 0	7 0
Lydenburg Est. (5s.)	13 0	14 9
Marsman Investments (10s.)	1 6	1 6
National Mining	1 6	1 6
Rand Mines (5s.)	4 1 0	4 3 9
Rand Selection (5s.)	2 1 0	2 3 9
Rhodesian Anglo American (10s.)	3 14 0	3 10 6
Rhodesian Corporation (5s.)	3 9	3 6
Rhodesian Selection Trust (5s.)	16 0	16 9
Rio Tinto (10s.)	3 1 0	2 19 0
Selection Trust (10s.)	4 8 0	4 6 0
South West Africa Co. (3s. 4d.)	16 3	16 3
Union Corporation (2s. 6d.)	2 4 6	2 4 3
West Rand Inv. Trust (10s.)	2 8 3	2 10 3
Zambesia Exploring	2 4 0	2 4 6

THE MINING DIGEST

A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Block Caving a Californian Limestone

The use of "Block Caving in Limestone at the Crestmore Mine, Riverside Cement Co., Riverside, California," is described by A. E. Long and L. Obert in Information Circular 7838 of the United States Bureau of Mines. The Crestmore mine, the authors say, is the only known example of block caving used to mine a limestone. The fact that the same deposit, at a lower horizon, is now being open-stoped is an indication of the strength of the limestone. Structurally it is one of the most competent rocks to be block caved.

Geology

Limestone deposits in the Crestmore area are probably remnants of Carboniferous formations that have been intruded by or enfolded in Jurassic granitic rocks. Since Jurassic time the limestones and associated intrusives have been tilted, faulted, and eroded. Most of the limestone deposits are blunt-edged thick lenses. Some extend to a considerable depth down dip. The Crestmore mine deposit consists of two lenses of metamorphosed and recrystallized limestone separated and surrounded by an igneous intrusive (granodiorite). The beds strike north-south and dip approximately 50° E., the strike length of the lower bed being approximately 2,500 ft. It is 270 ft. thick near the centre, tapering to a 100-ft. thickness near the lateral limits.

Metamorphism has almost obliterated the original bedding in the limestone. A remnant system of bedding is indicated principally by variations in mineral composition and by abrupt changes in the crystal pattern. The few true bedding planes that remain persist for only short distances and are generally tight and healed. These few planes are so tightly healed that drill cores seldom break along them and long pieces can generally be recovered even when the core has been cut perpendicular to the bedding planes. Sporadic zones of jointing exist in the limestone and, like the bedding, they are generally tight and healed. Solution channels in the limestone, ranging from minute cracks to large open cavities, are numerous near the surface. With depth they diminish in size and number. A few have, however, been found at a down-dip depth of over 300 ft. The solution channels tend to follow the general direction of pre-existing joint planes. Many are partly or completely filled with decomposed rock materials and with solution products. There are enough solution channels in the upper 200 ft. of the limestone to weaken the formation structurally. Hence these channels are believed to have had a significant effect on the initiation and maintenance of caving.

The limestone is a white fine- to coarse-grained crystalline rock. The fine and coarsely crystalline facies of the deposit are usually stronger than the sugar-like medium-grained varieties. Average magnesia-silica content of the limestone is low. The relatively high magnesia facies are usually finer grained and stronger than those containing less magnesia.

The intrusive rock forming the hanging and foot walls of the limestone lens is a grey coarse-grained quartz diorite (granodiorite) with occasional hornfels inclusions. The quartz-diorite is cut by joints spaced from a few inches to several feet apart. Fractures are rare and widely spaced. At 200 ft. below the surface the fractures appear to be tight. AX-size core up to 5 ft. in length has been obtained in and below this horizon in both the foot- and hanging-wall rock. Near the surface the diorite is weathered, as indicated by staining and claylike fill material in the fractures. An irregular zone of contact alteration not over 15 ft. thick occurs in the quartz-diorite directly above the upper surface of the limestone. Scattered within the first 5 ft. of this zone nearest the limestone-granodiorite contact are layered and irregular-shaped iron-stained blocks of hornfels. The thickness, width, and length of the hornfels blocks vary from 1 ft. to several feet. In some areas the hornfels masses are in contact with the limestone and in other areas they occur as inliers.

Petrographically the limestone can be broadly classified as recrystallized carbonates. The compressive strength of samples ranged from 6,700 lb. to 24,000 lb. per sq. in. The modulus of rupture (outer fibre tensile strength) ranged from 2,170 lb. to 2,360 lb. per sq. in.; hence, these marbles can be physically classed as relatively strong. The granodiorites appear to be weaker than a true granite, as a considerable portion of the hanging-wall granodiorite broke or crushed into a *minus*-¼-in. material as the blocks were caved. The hanging-wall material, which did not crush easily, usually contained large amounts of hornfels.

Mining Methods

The system and pattern of drives and tapping and transfer rises used throughout the operation

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:	Aug. 8, 1958 £ s. d.	Sept. 9, 1958 £ s. d.
SOUTH AFRICA:		
Blinkpoort (5s.)	2 7 3	2 8 9
Blyvooruitzicht (2s. 6d.)	1 2 6	1 3 0
Brakpan (5s.)	4 6	5 0
Buffelsfontein (10s.)	1 19 3	2 2 3
City Deep	13 9	14 0
Consolidated Main Reef	14 9	16 0
Crown Mines (10s.)	1 3 0	1 5 3
Daggafontein (5s.)	1 10 3	1 9 9
Dominion Reefs (Ord. 5s.)	12 0	15 0
Doornfontein (10s.)	1 5 6	1 7 3
Durban Roodepoort Deep (10s.)	1 9 3	1 7 9
East Champ d'Or (2s. 6d.)	1 6	1 9
East Daggafontein (10s.)	8 3	8 6
East Geduld (4s.)	1 5 0	1 4 9
East Rand Proprietary (10s.)	1 18 9	1 18 9
Freddies Consol	2 3	2 3
Free State Dev. (5s.)	5 6	5 3
Free State Geduld (5s.)	4 11 0	4 15 0
Free State Saaiplaas (10s.)	14 3	16 9
Geduld	3 2 9	3 3 0
Government Gold Mining Areas (5s.)	3 6	3 6
Grootvlei (5s.)	14 3	14 9
Harmony (5s.)	1 17 3	1 18 9
Hartebeestfontein (10s.)	3 3 0	3 7 3
Libanon (10s.)	7 6	8 0
Loraine (10s.)	2 6	2 6
Luipaards Vlei (2s.)	9 3	10 3
Marievale (10s.)	18 3	18 6
Merriespruit (5s.)	4 0	4 3
Modderfontein B (3d.)	2 9	2 9
Modderfontein East	13 6	14 0
New Kleinfontein	3 9	4 0
New Pioneer (5s.)	1 14 0	1 16 3
New State Areas (10s.)	2 0	1 6
President Brand (5s.)	2 16 0	2 19 0
President Steyn (5s.)	1 9 3	1 10 3
Rand Leases (10s.)	4 0	4 3
Randfontein	1 4 3	1 4 6
Riebeeck (10s.)	15 9	16 3
Rietfontein (4s.)	8 0	7 6
Robinson Deep (6s.)	10 3	10 9
Rose Deep (6s. 6d.)	10 0	10 3
St. Helena (10s.)	2 1 6	2 3 0
Simmer and Jack (2s.)	3 9	3 6
South African Land (3s. 6d.)	1 1 3	1 2 0
Springs (5s.)	1 9	1 9
Stilfontein (5s.)	2 0 6	2 4 9
Sub Nigel (10s.)	13 0	13 3
Vaal Reefs (5s.)	1 15 6	1 18 0
Van Dyk (7s. 9d.)	3 6	3 6
Venterspost (10s.)	14 3	15 0
Virginia (5s.)	7 9	7 9
Vlakfontein (10s.)	15 3	15 6
Vogelstruisbult (10s.)	7 9	8 9
Welkom (5s.)	14 9	17 9
West Driefontein (10s.)	5 1 3	5 3 9
West Rand Consolidated (10s.)	1 5 6	1 5 6
West Witwatersrand Areas (2s. 6d.)	2 5 9	2 6 6
Western Holdings (5s.)	4 19 0	5 4 0
Western Reefs (5s.)	1 8 0	1 10 9
Winkelhaak (10s.)	16 9	17 6
Witwatersrand Nigel (2s. 6d.)	1 3	1 3
RHODESIA:		
Cam and Motor (2s. 6d.)	8 0	8 0
Chicago-Gaika (10s.)	15 0	16 3
Coronation (2s. 6d.)	3 6	3 6
Falcon (5s.)	7 6	7 6
Globe and Phœnix (5s.)	1 8 0	1 10 0
Motapa (5s.)	6	6
GOLD COAST:		
Amalgamated Banket (3s.)	1 0	1 0
Ariston Gold (2s. 6d.)	4 0	4 3
Ashanti Goldfields (4s.)	15 9	15 3
Bibiani (4s.)	2 0	2 0
Bremang Gold Dredging (5s)	1 3	1 3
Ghana Main Reef (5s.)	1 9	1 6
Konongo (2s.)	1 7	1 6
Kwahu (2s.)	3 0	2 9
Taquah and Abosso (3s.)	—	—
Western Selection (5s.)	4 3	5 0
AUSTRALASIA:		
Gold Fields Aust. Dev. (3s.), W.A.	1 6	1 6
Gold Mines of Kalgoorlie (10s.)	8 9	8 6
Great Boulder Propriet'y (2s.), W.A.	12 9	12 3
Lake View and Star (4s.), W.A.	1 2 9	1 2 9
London-Australian (2s.)	—	—
Mount Morgan (10s.), Q.	10 6	9 3
New Guinea Gold (4s. 3d.)	1 6	1 6
North Kalgurli (1912) (2s.), W.A.	7 6	8 0
Sons of Gwalia (10s.), W.A.	2 3	2 3
Western Mining (5s.), W.A.	8 0	8 6

	Aug. 8, 1958 £ s. d.	Sept. 9, 1958 £ s. d.
MISCELLANEOUS:		
Fresnillo ($1·00)	2 2 9	2 1 0
Kentan Gold Areas (1s.), E. Africa	3	3
St. John d'el Rey, Brazil	2 15 0	2 14 3
Yukon Consolidated ($1)	4 9	4 6
COPPER:		
Bancroft Mines (5s.), N. Rhodesia	1 0 6	1 0 0
Esperanza (2s. 6d.), Cyprus	1 9	1 7
Indian (2s.)	4 6	4 6
MTD (Mangula) (5s.)	7 0	7 0
Messina (5s.), Transvaal	4 13 3	4 11 3
Mount Lyell, Tasmania	18 6	19 6
Nchanga Consolidated, N. Rhodesia	10 17 3	10 15 0
Rhokana Corporation, N. Rhodesia	27 0 0	26 10 0
Roan Antelope (5s.), N. Rhodesia	8 6	8 0
Tanganyika Concessions (10s.)	3 2 0	2 17 6
LEAD-ZINC:		
Broken Hill South (5s.), N.S.W.	2 4 6	2 3 9
Burma Mines (3s. 6d.)	1 9	1 9
Consol. Zinc Corp. Ord.	2 9 3	2 13 0
Electrolytic Zinc, Tasmania (Pref. 5s.)	2 12 6	2 12 6
Lake George (5s.), N.S.W.	4 6	4 3
Mount Isa, Queensland (5s. Aust.)	1 4 0	1 4 9
New Broken Hill (5s.), N.S.W.	1 12 6	1 12 9
North Broken Hill (5s.), N.S.W	3 15 0	3 10 6
Rhodesia Broken Hill (5s)	7 9	7 9
San Francisco (10s.), Mexico	17 6	18 6
TIN:		
Amalgamated Tin (5s.), Nigeria	5 0	5 9
Ampat (4s.), Malaya	6 0	6 3
Ayer Hitam (5s.), Malaya	1 2 6	1 4 0
Beralt (5s.), Portugal	1 5 0	1 2 6
Bisichi (2s. 6d.), Nigeria	2 9	2 9
Ex-Lands (2s.), Nigeria	1 9	1 9
Geevor (5s.), Cornwall	13 0	14 6
Gold Base Metals (2s. 6d.), Nigeria	9	9
Hongkong (5s.), Malaya	4 0	4 3
Jantar Nigeria (3s.)	2 0	2 0
Kaduna Syndicate (2s.), Nigeria	2 0	1 10
Kamunting (5s.), Malaya	8 3	8 6
Kramat Pulai (3d.), Malaya	3 0	4 3
Malayan Tin Dredging (5s.)	9 9	9 6
Mawchi Mines (4s.), Burma	1 6	1 3
Naraguta Extended (5s.), Nigeria	9	9
Pahang (5s.), Malaya	4 0	4 3
Siamese Synd. (5s.)	6 6	6 6
South Crofty (5s.), Cornwall	3 0	3 6
Southern Kinta (5s.), Malaya	15 9	16 6
Southern Malayan (5s.)	8 3	8 9
Southern Tronoh (5s.), Malaya	7 6	8 6
Sungei Besi (4s.), Malaya	13 9	13 6
Sungei Kinta, Malaya	12 6	12 6
Tronoh (5s.), Malaya	9 9	10 6
United Tin Areas (2s. 6d.), Nigeria	4½	6
DIAMONDS:		
Anglo American Investment	9 7 6	9 6 3
Consol African Selection Trust (5s.)	13 6	15 0
Consolidated of S.W.A. Pref (10s.)	11 0	11 3
De Beers Deferred (5s.)	5 5 0	5 9 0
FINANCE, Etc.		
African & European (10s.)	3 6 3	3 8 6
Anglo American Corporation (10s.)	7 9 0	7 16 3
Anglo-French Exploration	1 3 0	1 3 0
Anglo Transvaal 'A' (5s.)	1 12 0	1 15 0
British South Africa (15s.)	3 7 0	3 8 0
British Tin Investment (10s.)	14 0	15 9
Broken Hill Proprietary	1 18 0	1 19 0
Camp Bird (10s.)	10 0	11 3
Central Mining	3 4 9	3 6 0
Central Provinces Manganese (10s.)	1 9 0	1 10 6
Consolidated Gold Fields	2 14 0	2 15 0
Consolidated Mines Selection (10s.)	1 14 3	1 16 0
East Rand Consolidated (5s.)	1 3	1 3
Free State Development (5s.)	5 6	5 3
General Exploration O.F.S. (2s. 6d.)	4 3	4 6
General Mining and Finance	4 16 0	4 17 0
H.E. Proprietary (5s.)	8 6	11 0
Johannesburg Consolidated	2 6 0	2 6 6
London & Rhod. M. & L. (5s.)	7 6	7 9
London Tin Corporation (4s.)	7 0	7 0
Lydenburg Est. (5s.)	13 0	14 9
Marsman Investments (10s.)	1 6	1 6
National Mining	1 6	1 6
Rand Mines (5s.)	4 1 0	4 3 9
Rand Selection (5s.)	2 1 0	2 3 9
Rhodesian Anglo American (10s.)	3 14 0	3 10 6
Rhodesian Corporation (5s.)	3 9	3 6
Rhodesian Selection Trust (5s.)	16 0	16 9
Rio Tinto (10s.)	3 1 0	2 19 0
Selection Trust (10s.)	4 8 0	4 6 0
South West Africa Co. (3s. 4d.)	16 3	16 3
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Geology

Limestone deposits in the Crestmore area are probably remnants of Carboniferous formations that have been intruded by or enfolded in Jurassic granitic rocks. Since Jurassic time the limestones and associated intrusives have been tilted, faulted, and eroded. Most of the limestone deposits are blunt-edged thick lenses. Some extend to a considerable depth down dip. The Crestmore mine deposit consists of two lenses of metamorphosed and recrystallized limestone separated and surrounded by an igneous intrusive (granodiorite). The beds strike north–south and dip approximately 50° E., the strike length of the lower bed being approximately 2,500 ft. It is 270 ft. thick near the centre, tapering to a 100-ft. thickness near the lateral limits.

Metamorphism has almost obliterated the original bedding in the limestone. A remnant system of bedding is indicated principally by variations in mineral composition and by abrupt changes in the crystal pattern. The few true bedding planes that remain persist for only short distances and are generally tight and healed. These few planes are so tightly healed that drill cores seldom break along them and long pieces can generally be recovered even when the core has been cut perpendicular to the bedding planes. Sporadic zones of jointing exist in the limestone and, like the bedding, they are generally tight and healed. Solution channels in the limestone, ranging from minute cracks to large open cavities, are numerous near the surface. With depth they diminish in size and number. A few have, however, been found at a down-dip depth of over 300 ft. The solution channels tend to follow the general direction of pre-existing joint planes. Many are partly or completely filled with decomposed rock materials and with solution products. There are enough solution channels in the upper 200 ft. of the limestone to weaken the formation structurally. Hence these channels are believed to have had a significant effect on the initiation and maintenance of caving.

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The intrusive rock forming the hanging and foot walls of the limestone lens is a grey coarse-grained quartz diorite (granodiorite) with occasional hornfels inclusions. The quartz-diorite is cut by joints spaced from a few inches to several feet apart. Fractures are rare and widely spaced. At 200 ft. below the surface the fractures appear to be tight. AX-size core up to 5 ft. in length has been obtained in and below this horizon in both the foot- and hanging-wall rock. Near the surface the diorite is weathered, as indicated by staining and claylike fill material in the fractures. An irregular zone of contact alteration not over 15 ft. thick occurs in the quartz-diorite directly above the upper surface of the limestone. Scattered within the first 5 ft. of this zone nearest the limestone-granodiorite contact are layered and irregular-shaped iron-stained blocks of hornfels. The thickness, width, and length of the hornfels blocks vary from 1 ft. to several feet. In some areas the hornfels masses are in contact with the limestone and in other areas they occur as inliers.

Petrographically the limestone can be broadly classified as recrystallized carbonates. The compressive strength of samples ranged from 6,700 lb. to 24,000 lb. per sq. in. The modulus of rupture (outer fibre tensile strength) ranged from 2,170 lb. to 2,360 lb. per sq. in.; hence, these marbles can be physically classed as relatively strong. The granodiorites appear to be weaker than a true granite, as a considerable portion of the hanging-wall granodiorite broke or crushed into a *minus*-¼-in. material as the blocks were caved. The hanging-wall material, which did not crush easily, usually contained large amounts of hornfels.

Mining Methods

The system and pattern of drives and tapping and transfer rises used throughout the operation

at Crestmore were similar to those employed in block caving the porphyry-copper deposits at Ray and in the Globe-Miami district in Arizona. However, the physical properties of the material and the size of the blocks mined at Crestmore necessitated some modifications of the mining scheme as applied at Ray. These modified caving procedures and experience resulting from their application to caving limestone are of particular interest because they increase the range of ore strengths to which block caving may be applied.

The principal differences at Crestmore that necessitated a change from the Ray procedure were the type of rock and the depth of the cover. Although the Crestmore limestone contained a network of watercourses and accompanying areas deteriorated by solution the rock did not contain to any significant degree the fracturing and jointing normally characteristic of block-caving ground. The cover overlying the limestone was thin, ranging from 0 in some areas to about 375 ft. overlying block 4C. This maximum depth of cover affected only a small percentage of the total area caved. Hence, the weight on the blocks and correspondingly the stress in the limestone was slight, a factor that makes caving more difficult.

To induce and sustain caving in the ground it was necessary to effect measures that would concentrate the stress generated by the weight of a thin cover on localized areas near the lower surface of the blocks. These measures were either unique to this operation or were carried out to a degree greater than was required in normal caving. They were as follows :—

(1) The blocks were completely cut off on all sides by either vertical shrinkage (cut-off) stopes or by caved areas. The cut-off stopes extended from the mining and grizzly levels upward to the quarry floor or to the hanging-wall contact.

(2) The area that undercut each block to start the caving was much greater than that undercut in normal block caving. At the Crestmore mine an undercut area about 80 ft. by 200 ft. (16,000 sq. ft.) was generally required to initiate the cave and as much as 35,000 sq. ft. was undercut in one instance without producing a cave. In some porphyritic copper ores caving can be induced by undercutting an area as small as 625 sq. ft.

(3) To sustain caving a radically different system of draw control was developed. In normal block caving the most widely accepted practice is to pull equal tonnage from each drawpoint according to a predetermined daily schedule. By following this procedure funneling is minimized. At Crestmore no draw schedule was used and pulls were confined to those drawpoints underlying the areas of the block highly enough stressed to fracture and break the rock. The area under high stress was usually indicated by the presence of a relatively copious amount of powdered rock in the drawpoint chutes. Pulls were made and continued only from drawpoints where the powdered rock was evident until a substantial void, possibly 75 ft. in diameter, had been created. This arch over the void thus transmitted and concentrated the load to other localized areas in the block and the pulling accordingly was shifted to the drawpoints, where the presence of powdered rock in the chutes indicated a high stress area. Once the draw was started from an area it had to be continued at a rate sufficient to maintain a void. If the blocks were allowed to settle on the broken rock it would reconsolidate and a considerable effort would be required to re-initiate the cave. Sometimes reconsolidation was extensive enough so that the block had to be almost completely re-undercut to restart the caving action.

The mining method developed at the Crestmore mine was characterized by a number of factors, some of which are seldom experienced or applied in mining porphyry-copper and other similar deposits by block-caving methods. Some of these factors that contributed to the success of the operation at Crestmore might be advantageously applied to other caving operations where the characteristics of the ore and country-rock materials are similar to those at Crestmore. These factors are :—

(1) The rock arched instead of funneling when a sustained pull was confined to a particular set of contiguous drawpoints.

(2) Even though most of the daily production could usually be drawn from a single producing block, the amount pulled per day ranged from 700 tons to about 3,000 tons during the life of the mine. Under average caving conditions in other formations, as the porphyry coppers, this tonnage is a limited production. Factors limiting daily production in the Crestmore mine are :—

(*a*) After an arched void develops some time is required to allow the stresses in the block to re-adjust and for them to transfer and be concentrated to some area in the rock near the periphery of the void. The material in this peripheral area is overstressed and crushes and some powdered rock is produced. This powdered rock filters downward through the broken zone toward the drawpoint chutes, where it accumulates. A considerable time may elapse before enough powdered rock accumulates in one or several drawpoints to become noticeable and hence serve as an indicator that the rock overlying these drawpoints is broken enough to be drawn. The re-adjustment period and the time spent in seeking the drawable chutes, as evidenced by the accumulated rock powder, are non-productive.

(*b*) The draw must be confined to a restricted area of the block that can be pulled only from a few, usually contiguous, drawpoints.

(*c*) The location of the drawable area shifts erratically. No set routing of mine cars to specific transfer rises is possible and a continual time-consuming rerouting of car trains is unavoidable.

(3) About 30% of the limestone drawn was oversize. These oversize pieces were broken, either in the drawpoint chutes or on the grizzly level, by blockholing, mud capping, and bombs.

(4) Difficulty was experienced in caving the last 25% of the block. This was especially true where the granodiorite cover was thin or non-existent. Evidently the weight of the last 25% of the block and cover material was not great enough to cause good fragmentation.

(5) The major portion of the granodiorite cover crushed to *minus*-¼-in. material that dribbled down through the coarsely broken limestone blocks. As a result the limestone was substantially diluted by the granodiorite. Dilution is a serious disadvantage in most mines, but at the Crestmore mine it was advantageous because 20% of a material containing alumina and silica was needed, *plus* the Stanley limestone, to make a product from which a portland cement could be produced. The granodiorite, which was drawn with the limestone as a diluent, served as the source of the needed alumina-silica material.

(6) The strength of the limestone was such that little support was needed in either the haulage or grizzly levels. As the first blocks were developed the grizzlies and drawpoint chutes were reinforced with concrete. After a period of operation this concreting was found to be unnecessary and was discontinued. The fact that little support and virtually no maintenance were required in the underground workings contributed substantially to the economic efficiency and safety of the Crestmore operation.

(7) An advantage resulting from block caving in "hard" rock (limestone) was that all development work, the extraction of the pillars on the undercut level, could be performed well in advance of placing the blocks in production. Because developed blocks could be put into production on short notice by blasting out the undercut level pillars the mine production could be matched to demand with virtually no delay.

(8) A measure of mining efficiency is the production per man-shift. This could not be reconstructed over the entire life of the Crestmore mine, but from 1943 to 1951 a 30-man crew produced an average of 32·25 tons per man-shift. Daily production during this period averaged 967 tons. The mine crew consisted of 23 underground and seven surface workers.

(9) The safety record established at the Crestmore mine was exceptional. Between April, 1941, and June, 1953, the mine was operated without a single lost-time accident. Good management is generally the principal factor in achieving safety, but in underground work the stability of the ground is an element that cannot be ignored. As previously discussed under factor 6 the stability of the rock in the haulageways, cut-off stopes, undercut level, and particularly in the grizzly level contributed to the record of safety established at the Crestmore mine.

Diamonds from Prospect Samples

A paper by R. G. Weavind and A. A. Linari-Linholm in the *Journal* of the South African Institute of Mining and Metallurgy for July discusses "The Recovery of Diamonds from Prospection Samples" and deals with work carried out at the Diamond Research Laboratory in South Africa.

The authors say that the weight of samples sent to the laboratory varies considerably and this is the first factor deciding the subsequent treatment. Milling, however, is essential since not only does it serve to reduce the bulk of the sample but it also cleans the surface of any diamonds present thus rendering them more easily recoverable. The mills used are of three sizes—*viz.*, 4 in., 6 in., and 8 in. diameter by 9 in. to 12 in. long; whichever size is used depends on the amount of gravel to be milled. In the 4-in. mill the charge consists of 500 g. of ½-in. steel balls and 250 g. of gravel. The 6-in. mills are loaded with about 3 kg. of 1-in. balls and about half this quantity of gravel; the 8-in. mills use 12 kg. of 1-in. balls and about 6 kg. gravel. Each mill has sufficient water added to cover the charge and is operated at 50% critical speed. These quantities have been carefully determined and have been selected to avoid any danger of diamond breakage.

In the early stages of the milling operation no sound is emitted by the balls falling against the shell of the mill. As the gravel particles are reduced in size and turned to mud the balls strike the shell and the noise level rises. The amount of noise emitted and the time of milling is an indication of the degree of reduction of the gravel in the sample. Some experience is necessary to determine from the noise when milling has proceeded far enough, since the mineral constituents of samples vary so much that it is quite impossible to give hard and fast rules for this process; however, milling is not continued for longer than 2 hours. The use of "tracer" diamonds soon indicates if diamonds are being broken, especially if the "tracers" are selected from poor quality cleavage and broken stones.

After milling the contents of the mill are emptied over a 65-mesh screen, breakage of which is avoided by superimposing a heavy gauge ¼-in. mesh screen. It goes without saying that a good deal of trouble is taken to see that every single particle is washed out of the mill and also from the ball load which is caught on the coarser screen; splashing is also avoided. After thorough washing the contents of the 65-mesh screen are dried. When dry the sample is sized to + 6, − 6 + 20, and − 20 + 65 Tyler mesh. The quantity of + 6-mesh gravel is seldom large and is usually hand-sorted without further processing. The treatment of the other sizes depends on the quantity and the minerals which are present in them.

If, after milling, the sample still weighs more than 1·0 kg. the − 6 + 20-mesh gravels are separated electrostatically; if the weight is less than this heavy-liquid separation is applied. To avoid the danger of a small diamond being trapped in the machine and re-appearing in a later sample electrostatic separation is not employed on *minus* 20-mesh samples.

The concentrate from the separator, or, if the separator is not employed, the sample after milling, may contain relatively large quantities of quartz or other light materials. If this is the case then these are removed by flotation in bromoform. This is placed in a beaker, sufficient being used to immerse the sample to a depth of about 3 in. The sample is then slowly added, with stirring, to the liquid. The heavy particles and the diamonds sink while the lighter minerals, including the quartz, float and can be skimmed off.

Bromoform is expensive and in order not to waste any both sink and float fractions are washed in acetone after decantation of as much bromoform as possible. The bromoform-acetone mixture is then washed with water until all acetone is removed and the bromoform reaches its original specific gravity. It can then be re-used. The quantity of bromoform used on the samples varies, but the

average consumption over several months was 20 c.c. per litre of gravel separated in this way.

If the sink fraction from the bromoform separation is still too large, or if the sample contains too little quartz to warrant this treatment, a further separation is performed; in this case the diamonds are floated away from the heavy minerals. The liquid in this instance is a supersaturated solution of lead sulphamate which is heated to keep it fluid. The temperature to which the supersaturated liquid must be heated is determined by the specific gravity required; for example, at 3·64 S.G. which is the density at which diamonds are floated in this work, the temperature has to be kept at 80° C.; for lower ranges the temperature can be reduced. The temperature of the liquid is maintained by surrounding the liquid containers with water jackets which are thermostatically controlled. The separating funnels containing the liquid are placed inside electrically-heated water jackets which are fitted with glass windows. These permit the operator to watch the separation and to ensure that the separating funnels are thoroughly cleaned after each sample. In action the funnels are filled with the hot liquid and the sample slowly added; during addition the liquid is stirred to give any diamonds trapped in the heavy minerals a chance to float. Some samples separate into two distinct layers; with others again the two fractions mingle and the line of demarcation is not clear. The *plus* 20-mesh samples are left in the liquid for about 5 minutes to give the particles a chance to settle to the bottom of the funnels, but the *minus* 20-mesh samples may sometimes be left to stand for an hour, depending on the degree of separation attained. After separation has taken place the plug at the bottom of the funnel is withdrawn and the sink portion caught on a screen, the heavy liquid issuing at the same time passes through the screen to be caught in a metal container. When the sink portion has been removed the screen holding the sink is withdrawn, another inserted, and the float removed in the same way. The funnel is then washed with distilled water to remove all particles adhering to the sides, the washings being caught in the float screen. Before washing down the funnel the metal container is replaced by another; this is to avoid hydrolization of the salt which takes place on addition of excess water. It is possible to recover some lead sulphamate from the washings by the method which is given later.

Transferring the liquid from the funnel to the container cools it down and it is then unsuitable to be returned to the separating funnel. It must be restored to the original temperature by placing the container in a warming oven, where it stands for some time. Fresh liquid is taken from the warming oven as required, the oven thus forming a bank from which supplies are available. The temperature of the oven is kept at 80° C. which retards crystallization of the liquid while standing.

Both the sink and float portions of the samples are washed with hot distilled water, the washings being retained and added to those from the cleansing of the funnels. When a sufficient quantity has accumulated the water is evaporated to recover the lead sulphamate which is then regenerated by the method outlined below. There is, however, some loss due to the hydrolization of the lead salt in water.

To prepare the liquid 1,000 g. of commercial sulphamic acid, NH_2SO_3H, are dissolved in 2 litres of distilled water which is heated to a temperature of 80° C. to 85° C. To this hot solution 2,500 g. of commercial yellow lead oxide, PbO, is added slowly, the mixture being well stirred during addition and for 5 minutes after the final addition of the oxide. The solution is filtered and any precipitate discarded. The pH of the mixture should now be approximately 10·5; if the pH of the solution is less than 10 the salt will hydrolize yielding NH_3 and an insoluble precipitate containing $PbSO_4Pb(OH)_2$, etc. After filtration 100 ml. of concentrated ammonia solution (S.G. 0·88) are added to the liquid. The object of this addition is twofold: Firstly, it helps to retard crystallization of the liquid should the temperature for any reason be lowered and, secondly, it ensures that the excess ammonia will inhibit the hydrolysis of lead sulphamate.

To increase the specific gravity of the lead sulphamate solution it is evaporated until the required value is attained. To reduce the specific gravity the solution is diluted with hot distilled water. Some hydrolysis takes place on addition of the water and the liquid must be filtered before use. If it is necessary to clean the liquid after use it is diluted with the minimum quantity of hot distilled water, yellow lead oxide in slight excess stirred in—*i.e.*, until some remains unchanged—and the mixture filtered. The liquid is regenerated from dilute solutions by first evaporating the excess water then adding PbO in slight excess, finally filtering as above.

By the application of all or some of the above method the average sample received at the laboratory is reduced to about one-tenth of its former weight or about 2 kg. in all; about 20 kg. per day is treated in this way. Sometimes the minerals in the sample do not permit as much reduction; at other times better results are obtained. After the bulk of the sample has been reduced as much as possible the remainder, in the various size ranges, is hand-sorted for diamonds.

As previously mentioned, the *plus* 6-mesh material is seldom in any large quantity and is quickly disposed of. The $-6+20$ is sorted on a dull black surface using a five-power magnifying glass suitably suspended over the sample. The $-20+65$ portion is sorted grain by grain under a 6·5 power wide-field binocular microscope; a dark background is also employed in this case. The quantity of this fraction to be sorted varies between 10 g. and 100 g. per sample. The present staff to handle the samples consists of eight women, one of whom acts in a supervisory capacity and one junior official who looks after the heavy-liquid separation.

In the 12 months that this programme has been in operation only one of the "tracer" diamonds was lost. This is considered very satisfactory, as many of the stones weighed only $\frac{1}{400}$ carat; this size can only just be seen with the naked eye. The missing diamond was broken in milling. In addition to finding all but one of the tracers, five "original" diamonds ranging from $\frac{3}{400}$ to $\frac{1}{100}$ carat have been recovered. It is possible that diamonds can be missed when using the method described, but it is felt that as long as all the "tracer" stones are recovered then the possibility of any original diamonds being undetected is remote. No method of assaying is absolutely perfect and the best results are only achieved after experience and practice.

Recovery of Malayan Tantalum-Niobium Minerals

Bulletin No. 2 of the Malayan Department of Mines Research Division by H. W. Hockin contains a note on occurrences and methods of recovery of "Tantalum-Niobium Minerals in Malaya." The author, in his introduction to the Bulletin, says that the demand for concentrates containing tantalum and niobium aroused considerable interest in Malaya, where columbite is known to occur in important quantities associated with cassiterite in alluvial and eluvial deposits at Bakri in Johore and Semiling in Kedah. The high price paid at one stage for concentrates of tantalum and niobium led to an intensified search for the ores of these metals with the result that numerous samples of widespread origin were submitted for examination. Many samples contained small amounts of tantalum and niobium minerals, but, as examination proceeded, it became obvious that the problems of identification and interpretation of the textures shown by the individual mineral grains (All samples have been alluvial or eluvial.) were closely associated with the problems of concentration.

Apart from concentrates and heavy-mineral assemblages from the columbite-producing areas at Bakri and Semiling, samples from essentially cassiterite-producing areas have also been examined. These latter included: (*a*) Dredge concentrates from a number of areas, mainly in Perak; (*b*) final "tin-ore" concentrates produced by the re-treatment of dredge concentrates; (*c*) "middling" products rich in zircon and monazite produced during the re-treatment of mine concentrates, and (*d*) dumps of so-called *amang*.

The manner in which the tantalum and niobium occurs varies, but, using the broadest classification possible, it is generally in one or other of the following minerals or mineralogical associations: (*a*) As columbite (tantalite-columbite); (*b*) in rutile; (*c*) in cassiterite; (*d*) in ilmenite, and (*e*) as one of a number of complex metamict multiple oxides of Ta, Nb and Ti, often containing thorium and uranium.

The only mechanical methods available at the present time for the recovery of tantalum and niobium minerals in the form in which they occur in Malaya are gravity concentration, electrostatic (and high-tension) separation, and magnetic separation. Experiments with froth flotation have so far yielded only unsatisfactory results.

Some dredge concentrates particularly carry appreciable (Ta, Nb)$_2$O$_5$ values, with the cassiterite and ilmenite indicating that in many cases only a small fraction of the (Ta, Nb)$_2$O$_5$ content can be separated as a tantalum-niobium concentrate. As a typical example, a dredge primary concentrate may contain 0·4% (Ta, Nb)$_2$O$_5$ and include 25% cassiterite, containing 0·8% (Ta, Nb)$_2$O$_5$, and 60% ilmenite containing 0·2% (Ta, Nb)$_2$O$_5$, which leaves less than 0·1% of the 0·4% (Ta, Nb)$_2$O$_5$ to be contributed by columbite or other associated minerals. In some cases, on the other hand, values of nearly 1% (Ta, Nb)$_2$O$_5$ have been detected; most of the mixed oxides being contributed by columbite and niobian rutile, with minor amounts of metamict multiple oxide minerals.

The majority of the "tin-sheds" in Malaya, in which the primary concentrate from the dredge or mine is treated, depend upon hand-dressing for the recovery of the cassiterite as a high-grade concentrate (75% Sn) ready for despatch to the smelters. Magnetic separators are used for the separation of ilmenite, while high-tension separators and flotation are finding increasing use for the recovery of monazite and sulphides respectively. When hand-dressing is used, however, it is difficult to determine any exact flow-sheet, as the method of treatment may vary considerably according to the type and grade of primary concentrate being received. The hand-dressing methods also tend to cause a build-up of middling products with a very refractory mixture of minerals (usually relatively rich in tantalum and niobium minerals) which may then be re-treated for cassiterite recovery, resulting in further random distribution of the tantalum and niobium among a number of products. Where sulphides are present in the assemblage roasting is sometimes practised so as to break them down for easier separation. Such roasting or even natural oxidation of any sulphides present may further complicate matters.

By controlled standard treatment of the primary concentrate it has been found, first in the laboratory and then in full-scale treatment, that high-grade cassiterite concentrates can be produced (with a high recovery) by entirely mechanical concentration while, at the same time, minor heavy minerals—such as, columbite, monazite, and zircon—can be separated as secondary concentrates. Two basic types of flow-sheet have been utilized for this. In the first, for very low-grade concentrates, drying followed by low-intensity magnetic separation to remove ilmenite is used; in the second, for higher-grade primary concentrates, selective gravity separation is the first stage to separate only light minerals and some ilmenite. In the first process the non-magnetic product, after ilmenite removal, is further concentrated by gravity (tables) and a clean heavy-mineral assemblage obtained which is then treated by electrostatic (or high-tension) methods and further high-intensity magnetic separation and perhaps flotation. In the second basic method an exactly similar treatment is used on the gravity concentrate. It is not claimed that the very high grades achieved by hand-dressing can always be made in this way, but grades of 72%–74% Sn can be produced with little difficulty.

The method using magnetic separation as the first stage has many advantages in that very low-grade primary concentrates high in ilmenite can be dealt with and a marketable ilmenite recovered immediately, leaving an enriched non-magnetic product which responds excellently to gravity concentration on tables. Non-removal of some of the ilmenite by the magnetic stage is of no concern, as this mineral forms an excellent "middling" strip during the subsequent table treatment and enables a very clean heavy-mineral concentrate to be made. The use of small amounts of ilmenite in this manner is common practice in the treatment of beach sands.

By careful control of the magnetic separation stage an ilmenite concentrate not containing free columbite or other tantalum and niobium minerals can be separated, leaving the cassiterite, minor ilmenite and altered ilmenite, zircon, monazite, columbite, and other tantalum and niobium minerals ready for further concentration by gravity

and separation from interfering light minerals. Treatment of the heavy concentrate by electrostatic or high-tension separation can remove the zircon and monazite, leaving the remaining conducting minerals for separation by high-intensity magnetic separation. These latter stages will of necessity be somewhat complicated if a high recovery of columbite and other tantalum and niobium minerals is aimed at, while the presence of intergrowths often sets a limit to the recoveries and grades that can be obtained. For a particular concentrate which contained about 30% cassiterite and approximately 0·5% (Ta, Nb)$_2$O$_5$, by chemical analysis, which was contributed by (mainly) columbite, niobian rutile, minor metamict mixed oxides, and intergrowths of these minerals, a recovery of about 70% of the (Ta, Nb)$_2$O$_5$ was made in three final products which contained 7%, 21%, and 30% (Ta, Nb)$_2$O$_5$, respectively. Further treatment could perhaps improve these grades.

Pegmatites in Manitoba

A paper by J. F. Davies in the *Canadian Mining and Metallurgical Bulletin* for July gives an account of "The Lithium and Beryllium Pegmatites of South-eastern Manitoba" from which the following notes are abstracted. It is stated that a study of a limited number of dykes in the Winnipeg River area has revealed that the lithium minerals occur in the central parts of the dykes. Beryl, when present in the lithium dykes, occurs outside the lithium-bearing zones. Beryl, when it occurs in simpler dykes, lacking lithium minerals, is associated with the same mineral assemblage as that found in the beryl-bearing zone of the more complex lithium pegmatites—*i.e.*, with pink feldspars, quartz, and book mica.

Recognition of internal zoning is important for several reasons. First, it assists in making predictions regarding the distribution of the ore-bearing sections along strike and down dip; secondly, it draws attention to the necessity of investigating the interiors of flat-lying dykes which, on surface outcrops, may contain no lithium minerals, and thirdly, it provides some evidence regarding the origin and emplacement of pegmatite bodies.

Of prime importance are the beneficial effects of zoning on the extraction of lithium minerals from the pegmatite deposits. Lithium occurs in these dykes as five different minerals: Spodumene, lepidolite, amblygonite, petalite, and triphylite. Each of these requires separate treatment for the extraction of lithium. The nature of the zoning is such that each of the lithium minerals occurs, for the most part, in separate zones, permitting selective removal of the different minerals.

Origin

Some of the observations relevant to the origin of the pegmatites are summarized below:—

(1) The dykes are closely associated with the margins of batholiths of quartz diorite.

(2) There appears to be a crude regional zoning of the different kinds of dykes. The beryl dykes in particular are more closely related in space to the quartz diorite than are the lithium pegmatites. Many of them occur within the quartz diorite.

(3) The pegmatites occupy well-defined fractures in the country rock.

(4) The dykes exhibit internal zoning.

(5) Wall-rock alteration is either absent or limited to minor recrystallization.

(6) Evidence of replacement is not widespread.

(7) Crystal size increases toward the centres of the dykes.

It is concluded that the quartz diorite was the source of the pegmatitic material. The theory postulated by Page for the pegmatites of the Black Hills of South Dakota offers a logical explanation for the origin of the Winnipeg River pegmatites. In brief this postulates that the pegmatite formed, as cooling progressed, by fractional crystallization *in situ* of a pegmatite magma, giving rise to successive zones of differing composition and texture. As crystallization proceeded the proportion of mineralizers dissolved in the fluid increased and the remaining magma became less viscous, accounting for the increased grain size toward the centre of the dykes. The fact that the beryl dykes generally are situated closer to the quartz diorite than are the lithium dykes and that in those dykes in which both lithium minerals and beryl are present the beryl occurs in the outer zones and lithium minerals in the inner zones of the dykes is compatible with this theory.

Commercial Deposits

At present there is no production from any of the pegmatite deposits. The demand for lithium has not yet increased sufficiently to provide outlets for new production and future requirements cannot be predicted with any degree of confidence. Nevertheless future production from deposits in south-east Manitoba can be anticipated.

Six lithium-bearing dykes have been investigated by diamond drilling. Shafts have been sunk on two of these. The results of this work indicate total reserves of 21,500,000 units, or 430,000,000 lb. of contained Li_2O. Indicated tonnages of individual properties range from 600,000 tons to 8,000,000 tons. Grade varies from 1·28% to 2·13% Li_2O. The reserves consist largely of spodumene ore.

The deposits are readily amenable to mining and little difficulty in separating the various lithium minerals should be anticipated, as this can be achieved by selective mining where necessary.

The manner in which the spodumene is intimately intergrown with quartz and in part with feldspar will make concentration by grinding and flotation necessary. Tests conducted by the Mines Branch, Ottawa, indicate that reasonable recovery, yielding a concentrate containing 5% or more Li_2O can be obtained, using flotation methods. Decrepitation methods in which the spodumene is converted to the pulverulent beta form were less successful in yielding a high-grade concentrate with good recovery.

Attempts have been made to develop some of the beryl pegmatites. The results to date have been inconclusive. Cassiterite does not appear to be present in any dykes in amount sufficient to warrant even a small operation.

The zoned nature of the pegmatites will have a definite influence on the possibility of extracting certain minerals as by-products. Since beryl and

mica for the most part occur in zones outside the spodumene zones of the lithium dykes, it is unlikely that the extraction of beryl and scrap mica would be economical. On the other hand, the close association of columbite with beryl in the beryl dykes would permit the recovery of that mineral along with beryl should a profitable operation be possible. The production of feldspar along with beryl production is possible. In some cases feldspar could be recovered during the treatment of lithium ores.

The mineral pollucite, which is present in one spodumene deposit, occurs as a lens of relatively pure mineral, averaging about 28% Cs. It has been reported that 150,000 tons of this material is present and could readily be mined at small extra cost.

Trade Paragraphs

Priestman Brothers, Ltd., of Hedon Road, Hull, announce that their works are now established at this address and that they have vacated the old Holderness Engineering Works.

Sturtevant Engineering Co., Ltd., of Southern House, Cannon Street, London, E.C. 4, in their latest publication (No. 6510) deal with scrubbers for industrial dust collection in power stations and for other applications.

Henry Simon, Ltd., of Cheadle Heath, Stockport, in a recently produced illustrated booklet describe Entoleter impact mills for accurate particle size reduction. These are particularly suitable for friable material—such as, asbestos, ball clay, etc.

English Drilling Equipment Co., Ltd., of Palace Chambers, Bridge Street, Westminster, London, S.W. 1, announce that they have moved their offices from the City to this address. The new telephone number is Trafalgar 5474/8.

Wild-Barfield Electric Furnaces, Ltd., of Watford, announce that they have recently received from the United States an order for 28 750-lb. capacity mains-frequency induction-heated aluminium holding furnaces valued at nearly $300,000.

Oldham and Son, Ltd., of Denton, Manchester, recently announced a number of appointments on their staff as a result of which Dr. C. D. J. Statham, previously in charge of mining division sales, becomes general sales manager.

Boyles Bros. Drilling Co., Ltd., of Vancouver, and Newcastle-on-Tyne, in an illustrated leaflet give brief particulars of their range of products covering nine different types of diamond drills, drill pumps, and drill bits.

Crofts (Engineers) Ltd., of Bradford, have opened a subsidiary company—Crofts U.S.A., Ltd., with headquarters in Chicago. The new American company follows closely on the recent acquisition of new and larger offices and works for Crofts Canada, Ltd., in Montreal and Toronto.

Pollard Bearings, Ltd., of Ferrybridge, Knottingley, Yorks., have published a series of interchangeability tables for fan and water pump spindle bearings and clutch withdrawal bearings. The tables are available in either quarto sized sheets or in a useful well-bound pocket-book edition.

Whitehouse Industries, Ltd., of Ferrybridge, Knottingley, Yorks, have revised and reprinted their catalogue of Philidas self-locking nuts. Many types are shown as are also their applications. Dimensions tables and specifications complete a comprehensive work.

Telegraph Construction and Maintenance Co., Ltd., of Mercury House, Theobald's Road, London, W.C. 1, have recently produced two booklets. One of these describes Telcon glands for thermo-plastic cables available in three different series. The other covers the range of Telcon mass-impregnated non-draining cables.

Wrights Ropes, Ltd., of Birmingham, recently issued a folder giving cross-sectional illustrations of the 70 standard constructions of the steel wire ropes which they manufacture. Each is numbered and there is a note on the use for which the rope is suitable—e.g., haulage, winding, excavator, ropeway, etc. A leaflet also just issued calls attention to the company's mining ropes in locked coil, flattened strand, and other varieties.

Monsanto Chemicals, Ltd., of Monsanto House, Victoria Street, London, S.W. 1, have produced a new booklet on their dielectric fluids, Aroclors and Pyroclor, and the use of them in capacitors and transformers. Its 50 pages include many illustrations and graphs dealing with properties and applications, the compatibility of these dielectrics with other engineering materials, and the handling of the fluids.

Tecalemit, Ltd., of Plymouth, announce a new range of Nylon tubing which is made of lightweight, tough, heat and ultra violet light resisting material. There are numerous applications for this tubing which is resistant to oil, grease, and most chemicals. It can be used as lines for lubrication, hydraulic control, air, fuel and oil, chemicals, vacuum, coolant and liquid foods and applied to cars, commercial vehicles, and industrial machinery of all kinds.

Worthington-Simpson, Ltd., of Newark on Trent, issue several catalogues which give details of the range of air-compressors they manufacture. These comprise vertical double-acting water-cooled units in six sizes and piston displacements ranging from 183 cu. ft. to 890 cu. ft. per minute, the Monobloc series "M" in single-stage and two-stage models for duties in the range of 4·53 c.f.m. to 55·8 c.f.m., and oil-cooled rotary machines from 200 c.f.m. to 1,200 c.f.m. at 120 p.s.i.g.

E. J. Longyear Co., of 76 South Eighth Street, Minneapolis, Minnesota, recently announced the appointment of Rudolph C. Gebhardt, geologist and mining engineer, as manager of their mining division in succession to Dr. Donald M. Davidson, who became president of the company on July 1. Mr. Gebhardt was formerly senior geologist and mining engineer in charge of the company's consulting office in Denver.

BTR Industries, Ltd., of Herga House, Vincent Square, London, S.W. 1, in a new 52-page publication, deal with conveyors and elevators of interest to designers of mechanical handling plant and all users of belting. The handbook outlines the various types of natural and synthetic rubber belts available and gives useful information (including tabulated data) on practical features of design and maintenance. Safe working stresses, capacities, wear, and the effects of climate are typical of the subjects discussed.

Morgan Crucible Co., Ltd., of Battersea Church Road, London, S.W. 11, have issued a new leaflet descriptive of Sinterlink. This is a clutch facing which has recently been developed by the company and is particularly suitable for heavy-duty transmission because it withstands a temperature several times higher than will a fabric. The makers also claim for it a low wear rate. It consists mainly of sintered bronze particles with smaller particles of "free" lead and graphite, the whole having a porous structure.

Allis-Chalmers Manufacturing Co., of Milwaukee, Wisconsin (British representatives: Allis-Chalmers Great Britain, Ltd., Salisbury House, London Wall, London, E.C. 2, have recently published a review of their activities in 1957 under the title "Engineering in Action." This 36-page two-colour magazine was produced by the company's Industries Divisions which manufacture products for the generation, transmission, and distribution, of electric power, as well as a wide variety of equipment for all industries such as metals and mining, chemical, and petroleum

Rapid Magnetic Machines, Ltd., of Lombard Street, Birmingham, have produced a powerful lifting magnet to meet the need for equipment suitable for handling material from haphazardly stacked stockpiles. Hitherto circular pattern magnets have been used but without much effect, since this type suffered a disadvantage in that its penetrative qualities were disposed only at the centre pole. The new magnet is of rectangular form, its field ranging over the length of the operating face, resulting in a substantial increase in pay-load of approximately two and a half times that of a comparable circular pattern.

Simon-Carves, Ltd., of Cheadle Heath, Stockport, have published an illustrated booklet entitled "Civil Engineering." In this they give an outline of a variety of engineering and building projects in which they have been engaged and give some idea of the services they have of offer. Among items included are a colliery development scheme for the Scottish Division of the N.C.B., concrete structures including mine headframes, steel erection and precast concrete frames, railway siding, drainage, surveying, piling, and site preparation, soil mechanics and site exploration, for which they have a mobile laboratory, and quality control—e.g., concrete testing.

Cathodic Corrosion Control, Ltd., of Duncan House, Dolphin Square, London, S.W. 1, make available some particulars of their method of providing internal cathodic protection for steel pipes. Reference is made to the development of CX 3 alloy anodes for power impressed cathodic protection. Unit anodes are inserted in unlined pipe and the protective current is controlled externally so that there is no need to enter the pipe. Each scheme consists of the anode array, the distribution cables, and the power supply equipment. Once the design problems of the number and distances between anodes has been solved the remainder of the design details are normal electric distribution practice, it is stated.

W. Christie and Grey Ltd., of 4, Lloyds Avenue, London, E.C. 3, have published an illustrated booklet on vibration and shock isolation. This points out that no single material has the characteristics required for the solution of all problems and it is the company's business to give each case consideration with a view to designing the most suitable arrangement; investigation, vibration recording, and supervision at site are undertaken as necessary. A number of steel spring and rubber unit mountings are shown, particulars are given of rubber, cork, cork-rubber, and felt isolating materials, and steel spring suspension systems and viscous dampers are described.

Nordberg Manufacturing Co., of Milwaukee, Wisconsin, in a new two-colour, 18-page bulletin describe their range of V-type engines. Examples are shown of the significant advancements in diesel engine performance for V-type engines that are supercharged, supercharged and intercooled, and Supairthermal. Operated on diesel oil, Duafuel or spark-ignition gas the engines are available in 12 or 16 cylinders with 13 in. or 13½ in. bore and 16½ in. stroke. Outstanding design and construction features are explained and components described and illustrated. Applications throughout the world include central power stations, pipelines, and the mining and chemical processing industries.

Site Investigations Co., Ltd., of The Green, Southall, Middx., a subsidiary company of **Le Grand, Sutcliff and Gell, Ltd.,** in a new booklet describe their geological, drilling, and geophysical services which, used in the right balance, it is suggested, are the best all-round way of tackling underground exploration. After an introduction and an outline of the facilities which the company have to offer for mineral and rock testing, radioactive assaying, electrical, magnetic, gravity, seismic and radioactive surveys, and interpretation, the work goes on to consider applications. These include: Sand and gravel, civil engineering, water, borehole logging, and quarrying. The whole is attractively designed and illustrated.

General Electric Co., Ltd., of Magnet House, Kingsway, London, W.C. 2, announce that they have been commissioned by the National Coal Board to install a new coal preparation plant at Aberpergwm Colliery in South Wales. The contract, valued at over £650,000, will include in addition to the actual cleaning machinery, conveyors, screens, pumps, electric motors, switchgear and cabling, as well as the complete lighting installation. It is the twelfth such installation ordered from the G.E.C. in the past ten years. Anthracite is mined at Aberpergwm and the whole run-of-mine output will be mechanically washed in the plant, the daily quantity being of the order of 3,500 tons. Provision will also be made to enable coal from neighbouring pits to be passed through the new installation. Only two processes will be employed—the Chance sand flotation process for the sizes above $\frac{1}{16}$ in. and the froth flotation process for the fraction below $\frac{1}{16}$ in.

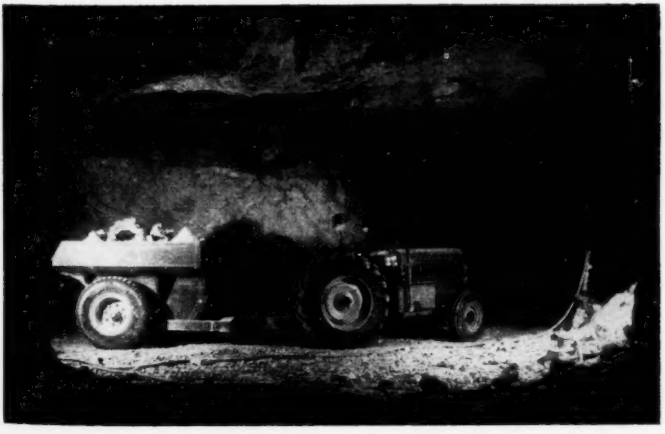
United Steel Companies, Ltd., of 17, Westbourne Road, Sheffield, announce that the National Coal Board has purchased a £50,000 continuous miner which will win, it is stated, considerably more coal per shift than is being obtained from any coal-mining machine at present operating in Europe. The Goodman continuous miner, which has been developed to a high degree of efficiency in the United States from a British coal-getting machine, has been assembled in Cumberland with all-British electrical equipment by **Distington Engineering Co., Ltd.,** who are the sole licensees for the United Kingdom. Two large four-armed rotors and an outer cutting chain comprise the cutting mechanism, both rotors and chain being equipped with a number of cutting picks. The machine bores into the coal face at the

Hunslet Locomotive in Newfoundland.

rate of 10 to 15 in. per minute over an area of 7 ft. 6 in. high by 13 ft. 6 in. wide. Simultaneously the cut coal is automatically fed back through the centre of the machine to a discharge conveyor. Several years' experience of the machine in an American coal mine have shown that it is capable of producing between 600 and 1,000 tons of clean coal per shift under varying conditions, working 24 hours a day. Because of its high potential output conventional equipment for conveying coal away from the face could not keep pace with the miner and new conveying equipment has had to be devised.

F. Perkins, Ltd., of Peterborough, in reference to the accompanying illustration, state that four of these Hunslet locomotives fitted with Perkins P4 diesel engines are in use in the Tilt Cove Copper Mine in Newfoundland. They are 5¼-ton diesel mechanical units and are owned by the Maritime Mining Corporation, Ltd. The Tilt Cove Copper Mine covers an area of 4 sq. miles and is on the north coast of Newfoundland. It can be reached by sea only in the summer months. The Hunslet P4 diesel locomotives were ordered following their success in copper, nickel, and uranium mines in other parts of Canada and are used for handling spoil taken from the development workings and also bringing in materials. Shaft sinking has reached an advanced stage and the mine can also be entered by two adits. A mill of 3,000 tons a day capacity is under construction. When development work is finished the locomotives will be responsible for hauling the major part of the mine's production. They will handle ten-car trains made up of 100-cu. ft. Granby-type cars, each weighing approximately 9 tons loaded. The tractive efforts of these locomotives in first gear is 3,140 lb. at 3·85 m.p.h. and 1,570 lb. in second gear at 7·7 m.p.h., the maximum speed.

Ford Motor Co., Ltd., from their Tractor Division at Dagenham, Essex, make available some notes on underground haulage by tractor, referring to the operation by J. C. Staton and Co., Ltd., of their



Tractor Trailer Haulage Underground.

gypsum mine at Fauld, near Uttoxeter, Staffs., where tractor-trailer haulage is a part of a current modernization programme. The Fauld mine, it is pointed out, has been in existence for nearly 200 years and is a confusing labyrinth of tunnels and caves running miles underground. From a concrete portal let into a hillside a straight haulage road has now been driven for a mile and a quarter through the old workings to within easy reach of the current faces. The tunnel is lined by steel girders and mesh, behind which is packed rock filling up the gaps left by earlier mining. Endless-rope haulage conveys the mine's 3,000 tons a week output to the crushing plants at the surface in metal railway wagons. In addition to gypsum a small quantity of alabaster is also extracted in block form.

At the working face the old method of mining has been replaced by a fully-mechanized system and a single-day shift is worked, shot-firing being undertaken by night in holes drilled for the charges by Atlas Copco machines. The displaced rock is removed from the face in four 7-ton Fauld designed tip-up trailers. These are mechanically filled by Eimco 621 electrically-operated loaders and are towed between the face and the railhead loading point by 40-h.p. Fordson Major diesel tractors. These rubber-tyred vehicles, modified with special filters to purify exhaust fumes, are in replacement of the rail-borne diesel locomotives formerly used. Four of them cover some 25 miles a week below ground for a consumption of 5 gal. of diesel fuel. They are maintained entirely below ground in a spacious garage provided by the lofty mine workings and so far have run virtually trouble-free. It is the management's intention to replace each tractor with a new machine every three years.

RECENT PATENTS PUBLISHED

☛ A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

28,949 of 1950 (800,629). U.K. Atomic Energy Authority. Extraction of uranium from ores.

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3,608 of 1956 (799,551). Texaco Development Corp. Reduction of metal oxides with carbon monoxide and hydrogen.

16,412 of 1956 (800,612). Ateliers des Charmilles S.A. Reduction of oxide iron ores.

17,806 of 1956 (800,586). National Smelting Co., Ltd. Condensing of zinc in liquid form from zinc vapours.

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240 of 1957 (800,647). Pyror, Ltd. Treatment of ores or concentrates containing iron sulphide.

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14,491 of 1957 (800,020). Separation of solids in a liquid suspension of comminuted solids.

NEW BOOKS, PAMPHLETS, ETC.

☛ Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

The Science of High Explosives : American Chemical Soc. Monograph 139. By Melvin A. Cook. Cloth, octavo, 440 pages, illustrated. Price 180s. London : Chapman and Hall.

Wahl und Beurteilung von Abbauverfahren im Bergbau : Prinzipien für den Abbau von Lagerstätten. By B. Stoces. Cloth, octavo, 411 pages, illustrated. Price DM 43. Stuttgart : Ferdinand Enke Verlag.

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Northern Rhodesia : Mines Dept. Report, 1957. Paper folio, 21 pages. Price 2s. 6d. Kitwe : Commissioner for Mines.

Ceylon : Report of the Government Mineralogist, 1957. Paper covers, 19 pages. Price 50 cents. Colombo : Government Publications Bureau.

Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

* Article in the present issue of the MAGAZINE.

† Article digested in the MAGAZINE.

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